The FOUNDRY

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Castings Save Many Hours for the Housewife

DEVELOPMENT of various types of machinery gradually is eliminating much of the drudgery connected with operating the American home. Vacuum sweepers, washing machines, ironing machines and numerous other devices have lessened the task of the housewife and have created more time for leisure. Surveys recently made

Much of the Work Necessary in Preparation of Foods Is Performed by Machinery *Courtesy Kitchen Aid Mfg. Co.*

show that the preparation of foods, including cooking and baking, require an average of 3.08 hours each day in a seven room home and a three child family. Equipment now has been introduced to lessen greatly the time spent in the kitchen. A machine designed for the purpose will perform mechanically a large number of operations, such as mixing dough, mashing potatoes, beating eggs, cutting shortening into flour, creaming butter, whipping cream and mayonnaise, straining fruit, sieving peas or beans for purees, chopping meat, grinding coffee, shredding cabbage, slicing fruit, extracting fruit juices, chipping ice and freezing ice cream. The product of the foundry plays an important part in performing these tasks, for castings are used for the base and frame of the machine and numerous attachments. Castings also are employed extensively in other equipment used in the modern kitchen.

Find Where Castings Can Be Sold.

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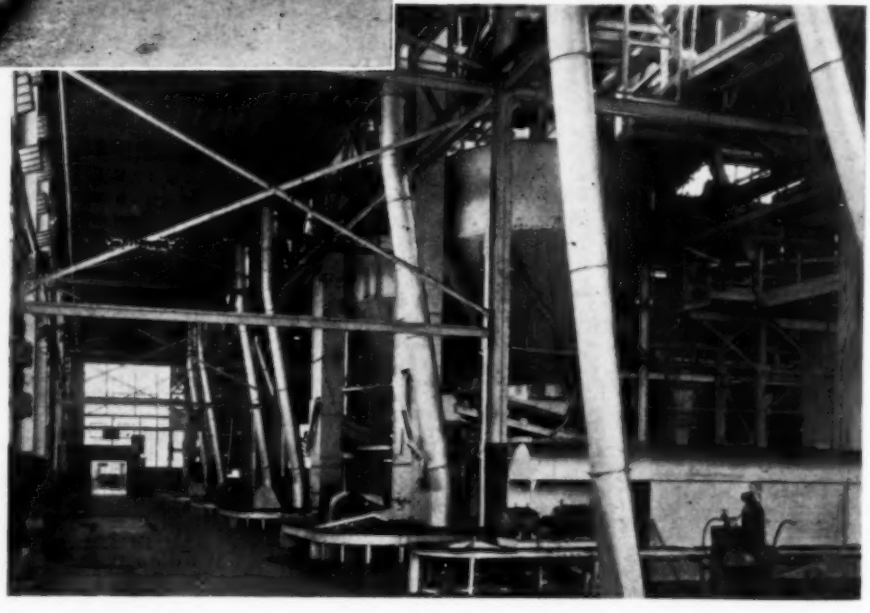
AUTO

By Pat Dwyer

Fig. 1 (Left)—Style of Flask, Runner Basin, Conveyor and Method of Pouring Fly Wheel Castings Are Shown. Fig. 2 (Below)—Three Main Sand Supply Hoppers Are Located at the North End of the Foundry



SEVERAL years ago some of our most popular business forecasters and professional statisticians sounded a note of warning not once but many times, which means every occasion they could induce a small or large number of people to listen. Invariably they viewed with alarm many signs and portents in the business sky, but particularly they were exercised over one extra black cloud. Dropping for the time being, all minor differences of opinion on the probable effects of prohibition, farm relief, federal reserve system and a nationally owned merchant marine, all prophets—major and minor—focussed their professional glasses on this dark spot in the industrial sky.

Through some peculiar twist in his mental makeup, man always has been more inclined to lend a willing ear to bad news, than he has been to a notification that the sun is about to burst forth. He hopes for the best but he dreads the worst. Human nature has changed but little if any during the long centuries that have elapsed since Noah was told confidentially that he was about to take a long journey across water and that he was going to lose practically everything except his key ring and the clothes in which he stood. This was one of the instances in which the dismal prophecy was fulfilled.

In the present instance, these inspired gentlemen who sounded the notes of warning and viewed things generally with alarm, were deluged with luncheon and dinner invitations from groups of men who wanted to hear the sad tidings directly from headquarters. Earnest young newspaper reporters aspiring to a financial desk and a by line, reported the prophecies in full. Others with a cynical tongue stuck in the cheek, knowing little of and caring less for the subject, painted the picture even blacker by skilful omission of certain parts of the context. Prognosticators and forecasters with large leather cases containing charts without number, hurried from one meeting to another in the years 1920 and 1921. They unrolled the charts one by one and quoted a truly astounding miscellany of figures to prove that the black menace in the sky, by this time offcially designated and recognized by all and sundry, as the *saturation point in the automotive industry,* was due in our midst in possibly one and certainly not more than two years. The concluding thought which each earnest speaker begged to leave with his audience was couched in a variety of forms, depending on the speaker's personal

Foundry Incorporates *New Design* in Equipment and Practice

preference for certain words, but the essence was the same in all cases: Be prepared! Look out! Stand from under! The automobile business is due for a flop!

These ringing words and the earnest messages which preceded them were taken seriously by all members of the community with perhaps two exceptions. Curiously enough these two exceptions were the men engaged in the production of motor cars—and the men who bought them!

Prophets and their followers have been standing expectantly—in some instances eagerly—on the side lines for the past several years waiting to see the last car roll down the delivery line. They have waited to see the credit line drawn so sharply that no person but a man with cash in hand can buy a car. They have bent one ear forward to hear the doors bang shut for the last time in the big automobile plants.

Mounting production year by year tried their faith cruelly and some almost capitulated.

Up to the present none has come forward boldly and admitted that as a prophet he is a washout, but it is significant to note that the term *automobile saturation point*, practically has disappeared from the language, written or spoken. Cars are rolling down the delivery lines in greater volume than ever before. Credit conveniences have been extended to enable almost any person who is not in jail or in an institution for the feeble minded, to drive and—in time—own a car. Instead of closing their factory doors, automobile makers are either running double and in some cases triple shifts, or, they are building additions to their plants.

According to generally accepted opinion, large corporations have no souls. Probably this may account in some measure for the fact that the General Motors Corp., apparently paid not the slightest attention to the earnest gentlemen who were shouting *automobile saturation point* from

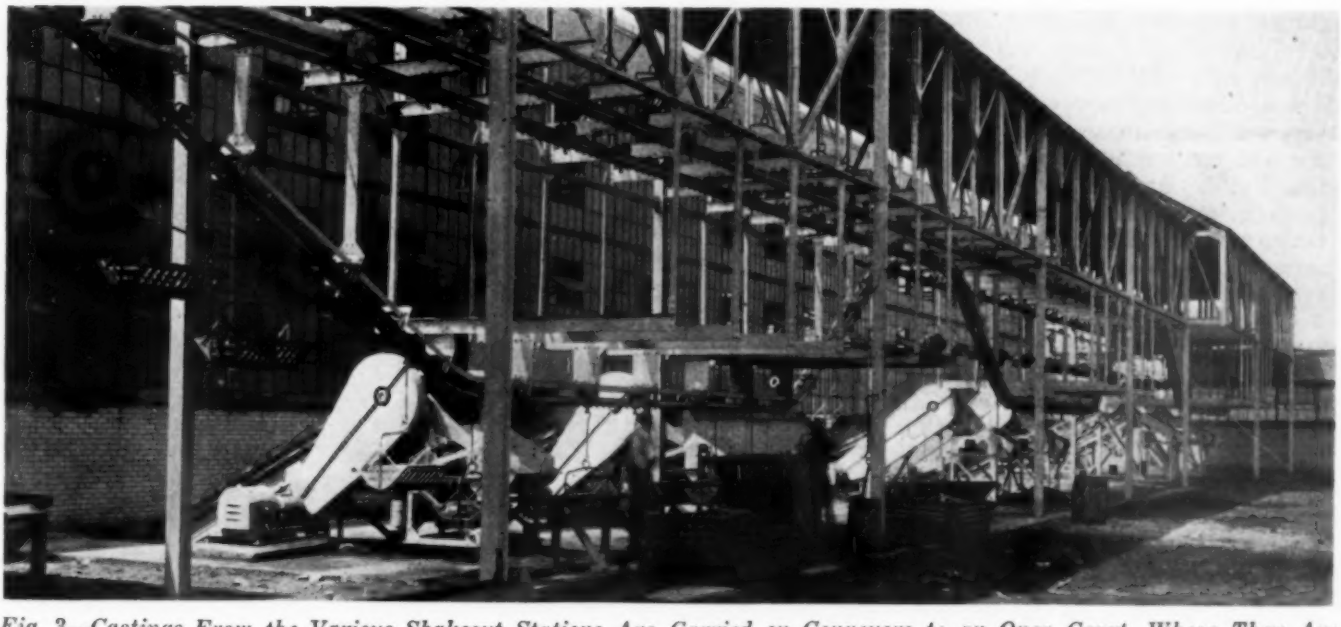


Fig. 3—Castings From the Various Shakeout Stations Are Carried on Conveyors to an Open Court, Where They Are Discharged into Steel Baskets Suspended From Aerial Conveyors

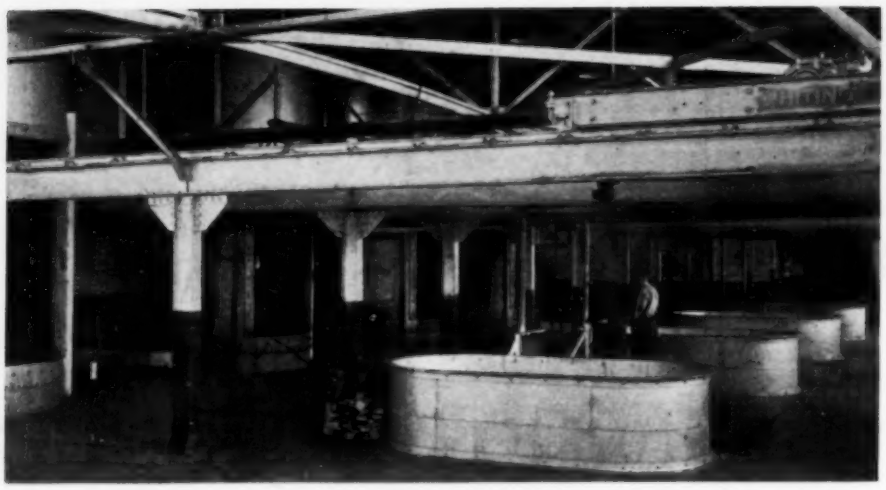


Fig. 4—An Individual Crane for Each of the Four Cupolas Lifts the Coke, Iron and Limestone From the Ground Floor Through the Openings in the Charging Floor and Discharges the Materials into the Cupolas

the housetops. On the contrary it has carried on an extensive building program during the past 10 years. In addition to general plant and office buildings the program has included a foundry at Detroit for the Cadillac Motor Car Co., a foundry at Saginaw, Mich., originally designed for a production of 200 tons per day, later increased to 700 tons, and then further increased by the erection of a second unit of equal capacity; a new foundry for the Buick Motor Co. at Flint, Mich., and a new foundry recently erected and placed in operation at Pontiac, Mich., adjacent to the plant of the Oakland Motor Co. at the north end of the city. This new foundry has been designed for an ultimate capacity of 600 tons per day and—so far as the casual visitor may note—no person connected with the establishment is worrying over the *saturation point*. In fact the only cause of worry is how to catch up with production schedules and meet demand.

Fast Work

The continuous type of foundry as known today in the automotive industry is a comparatively recent innovation. The General Motors Corp., through its engineering staff and foundry personnel probably has done more than any other organization to bring this type of foundry to perfection. In projecting the new foundry at Pontiac it selected a member of the engineering staff, J. E. Linabury, who had been intimately connected with the planning, erection, installation of equipment and operation of its foundries in Detroit, Saginaw and Flint. He had opportunity of observing merits and demerits in plans and equipment and therefore had an unusual background of knowledge and experience on which to base his opinions and from which to draw his conclusions. He was appointed foundry manager and given practically a free hand in the design and equipment of a foundry as representative of the advancement in foundry practice and technique as the new cars represent improvement in all essential features. In effect the corporation said "Let's have a 1929 model foundry."

An appropriation for carrying on the work was made late in June 1928 and with this in one hand, figuratively speaking, and a spy glass in the other, the new manager started out to find a site, to build up an organization and to place contracts with various firms engaged in the business of building and equipping foundries.

About two years ago the Oakland Motor Co., outgrew its downtown plant and built an extensive new plant on the northern outskirts of the city. Fortunately this property was greatly in excess of immediate requirements and a section readily was set apart for the proposed new foundry. Experts from the Austin Co., Cleveland were called into consultation to design a building to meet certain definite requirements. Twenty-five days later a complete set of drawings was delivered by the Austin Co., and the job fairly was under way.

Prominent manufacturers of foundry equipment showed a commendable spirit of cooperation by installing their various units as fast as they could be accommodated in the buildings, with the result that the first cylinder block casting was poured March 21, 1929, or approximately three months inside the period set in the original estimate. This does not mean that the shop was functioning to full capacity. Necessarily some time must elapse before this goal is reached but it indicates that the various parts were in working order when subjected to actual test under operating conditions.

Melts 150 Tons Daily

By the first of June approximately 11 months after the starting shot was fired and the word given to "Go" in the race against the most relentless of all competitors, *Time*, three of the seven units were in full operation and the daily heat had risen to 150 tons. Nearly all the remaining equipment was in place and probably will be functioning before this description appears in THE FOUNDRY.

Engineers of the Austin Co., Cleveland collaborated with the foundry manager J. E. Linabury and with L. A. Blackburn of the Oakland

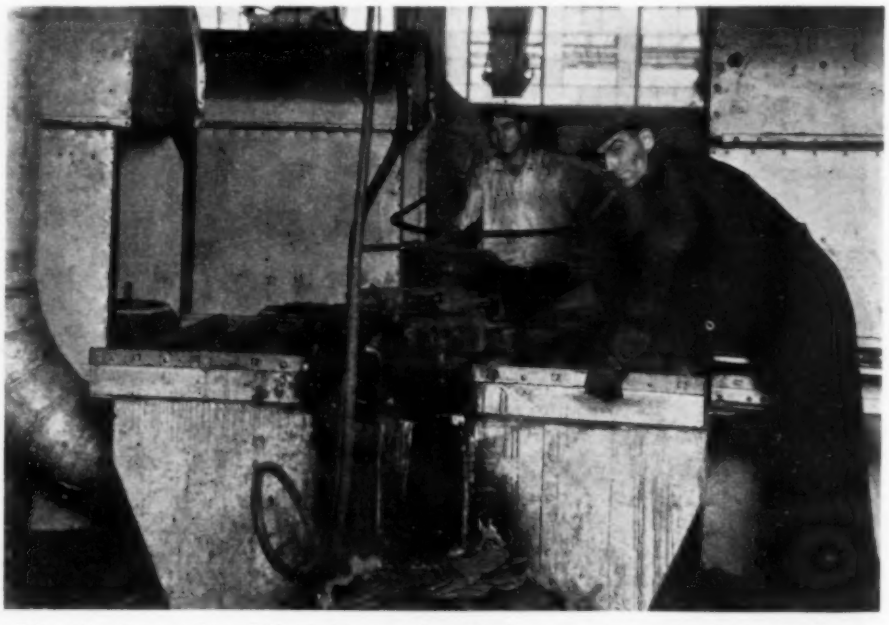


Fig. 5—Copes Are Lifted From the Moving Flasks and Held Against a Vibrating Apparatus Which Shakes the Sand Out of Them

Motor Car Co., engineering staff who was actively in charge of erection and installation of equipment. All the general features were decided upon in advance, but minor modifications were introduced in the design of some parts of equipment formerly regarded as fairly standard. In some instances the modification came as the result of a suggestion by an individual. In others it represented a compromise or rather a composite of the views of several men. Thus the adoption of the vertical instead of the usual horizontal type of core oven represents the personal choice of the foundry manager. The special type coke handling device for the cupolas passed through several imaginary stages before the finished idea was handed over to the C. O. Bartlett & Snow Co., Cleveland, for conversion into the actual reality as it now appears in the new foundry of the Oakland Motor Car Co.

Operation at full or nearly full capacity for the coming year, probably will demonstrate the advisability of changing some of the features—actual experience is a wonderful eye opener—but at the moment, this foundry represents the highest development in the application of methods and equipment to the production of gray iron castings for automobile engine castings that the General Motors Corp. has attempted.

Gives General Layout

The foundry occupies a space south and east of the extensive group of buildings in which Oakland and Pontiac cars are fabricated, assembled and finished. On the east it is served by the main highway between Pontiac, Flint and Saginaw on the north and Detroit on the south. On the west it is served by several spur tracks leading to the main line of the Grand Trunk railroad. General arrangement of the foundry group of buildings and disposition of the spur tracks may be noted in the illustration Fig. 10. The upper track is laid past the loading platform. The second track brings sand to the sand storage building which has a capacity of 450 car loads, between 12000 and 15000 tons. The lower track is divided at a point about 300 feet from its southern destination. One branch conveys iron of various compositions to the stock-yard while the other brings coke, limestone and iron borings to a point where they are unloaded into suitable receptacles to be described more in detail in a succeeding article devoted to a description of the melting practice.

Territory shown to the left in the same illustration is considerably lower than the floor line of the buildings and therefore is well adapted for the reception of waste sand from the room where the cylinder cores are knocked out. The sand falls into a water tank where it constantly is kept agitated and from which the mixture is pumped through a long pipe line to the dumping ground. The water drains away and the accumulated sand is allowed to build up to the desired level. Then the discharge end of the pipe is shifted to another location. This is one of the shop kinks borrowed from the Saginaw plant of the corporation where it has been in operation for several years (See THE FOUNDRY June 15, 1926).

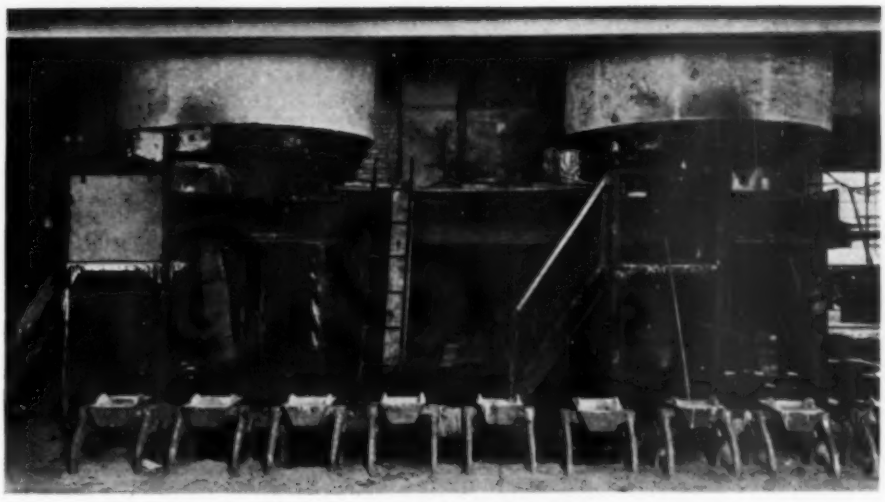


Fig. 7—A Special Chamber for Preheating the Blast Is Located Between the Two Cupolas, Which Are Used on Alternate Days

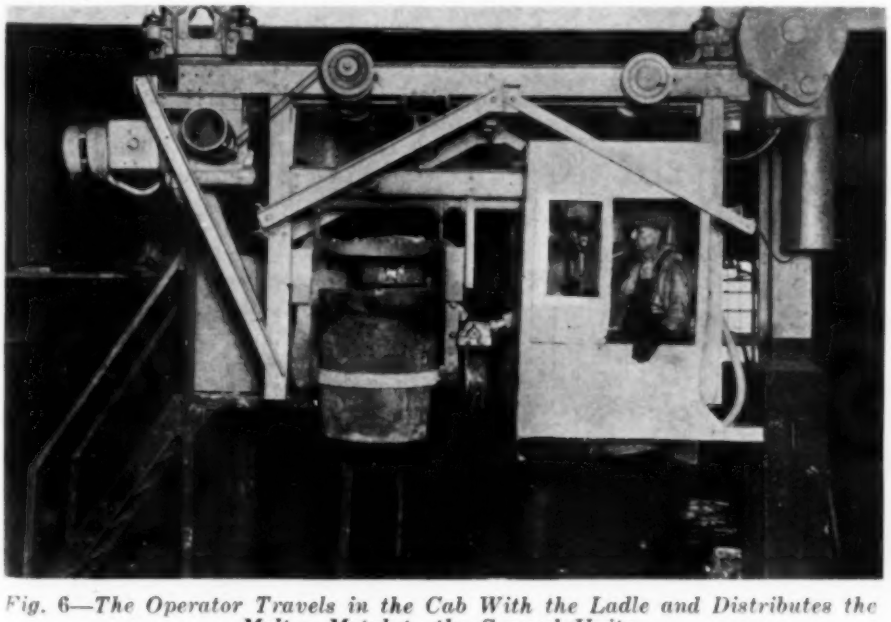


Fig. 6—The Operator Travels in the Cab With the Ladle and Distributes the Molten Metal to the Several Units

New Type Foundry Layout

The open court, or areaway shown in the center of the illustration, Fig. 10 represents a new departure in foundry layout. It effectually separates the core making department from the foundry proper where the molds are made and poured. This form of construction secures complete autonomy to each department with resulting advantage in operating conditions and in the natural features, light and ventilation. A covered passageway at either end of the areaway connects the core room with the foundry. Cores are loaded on automotive trucks and carried through the passage shown on the right, into the foundry where they are placed in the waiting molds.

Core sand and facing sand are prepared in the space west of the core room and south of the sand storage. The core sand is prepared in a battery of mixers made by the Standard Sand & Machine Co., Cleveland and is distributed to the various core maker's benches by a bucket suspended from a monorail. This equipment was installed by the Chisholm & Moore Co., Buffalo, and is similar to

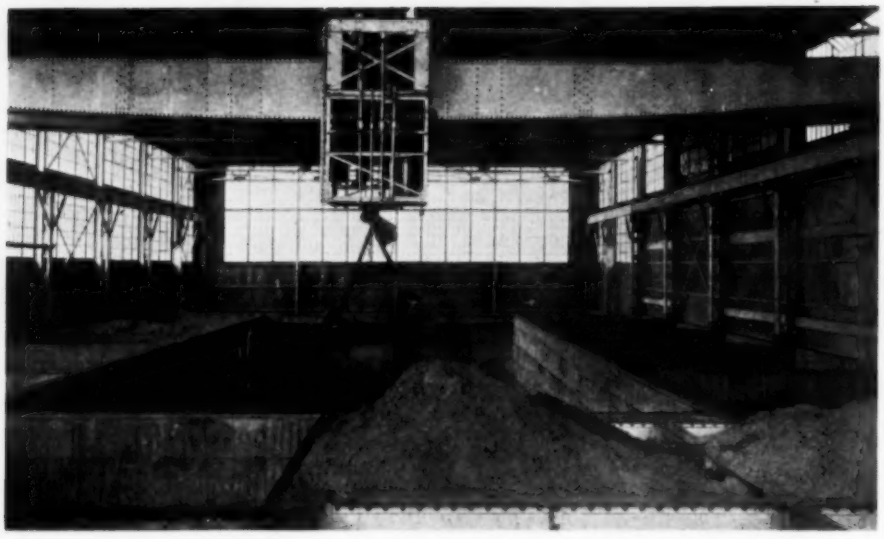


Fig. 8—Molding and Core Sand Are Stored in a Series of Concrete Bins

that placed in the new foundry of the Cadillac Motor Car Co., a few years ago and described in THE FOUNDRY, Sept. 15, 1925. Facing sand is prepared in equipment supplied by the National Engineering Co., Chicago. This equipment presents several interesting features, particularly in the manner in which the various ingredients are placed in the pan. These features will be taken up more in detail in a future article in this series.

Conservation of floor space is claimed for the arrangement in the coreroom whereby each one of the 16 continuous vertical ovens serves a group of coremakers. This arrangement does away with all trucking of green cores. The core is taken direct from the machine and placed in the oven.

An entirely new type of oven has been developed for drying the cores after they have been blacked and pasted. It is operated hydraulically and was designed primarily to eliminate the usual sprocket and chain. Many interesting features in connection with the construction, method of operation, also results obtained, will be presented in a future article dealing specifically with the coremaking department.

Molds are made on seven conveyor units equipped with molding machines made by the Osborn Mfg. Co., Cleveland and the Wm. H. Nicholls Co., Richmond Hill, Long Island, N. Y. Molding sand is prepared and distributed through an extensive system installed by the Link-Belt Co., Chicago.

Castings are dumped through openings in the floor close to the north end of the foundry building and are carried upward on conveyors and dumped into steel baskets suspended from a series of cooling conveyors in the areaway between the foundry and core room. After passing through a series of long or short loops, depending on the size, the castings are dropped in the cleaning room, separated from the combined foundry and core room buildings by an open space

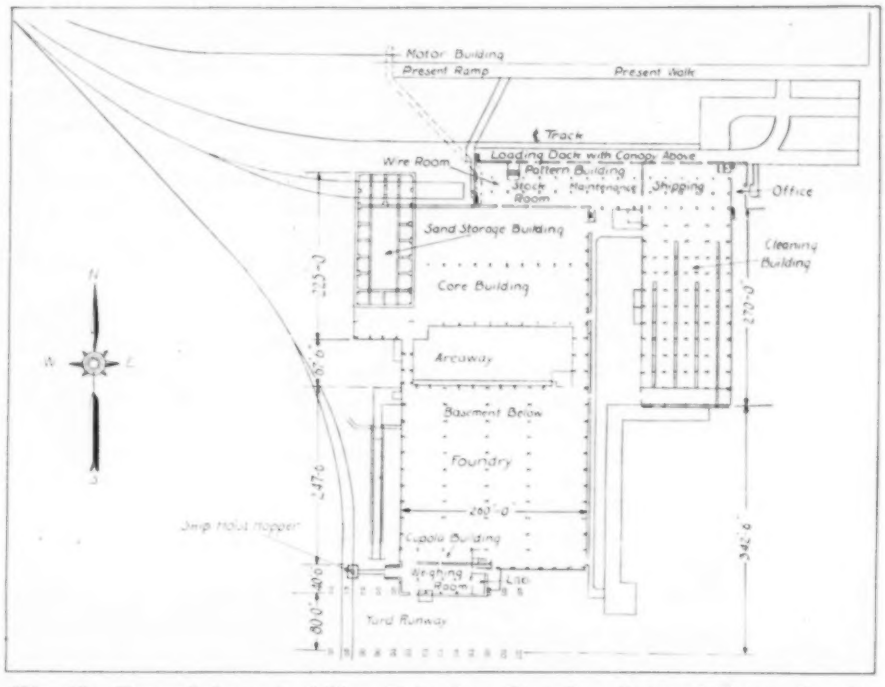


Fig. 10—General Layout of New Gray Iron Foundry, Oakland Motor Car Co., Pontiac, Mich., Showing Relative Position of the Various Units

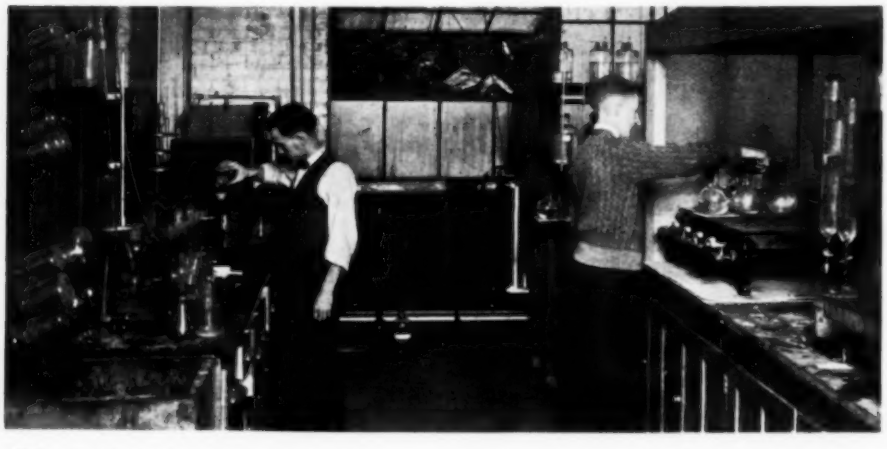


Fig. 9—Metallurgical Laboratory on the First Floor Is Supplemented By a Sand Testing Laboratory on the Second Floor

60 feet in width. The cylinder blocks do not pass into the areaway, but are picked up directly at the shakeout station and carried on the aerial conveyor to a small building shown at the extreme lower right corner of the stockyard. Here the cores are knocked out in a machine made by the Stoney Foundry Engineering & Equipment Co., Cleveland. The machine is located on an upper floor and functions while the casting is in transit.

This is the first of a series of four articles describing in considerable detail the plant, equipment and methods employed at the new foundry recently erected and placed in operation at Pontiac, Mich., by the Oakland Motor Car division of the General Motors Corp. Succeeding articles of the series will be presented in early issues of The Foundry.

London Congress Furthers *Foundry Industry*

Delegates at Third International Meeting Develop Valuable Information by Discussing Various Problems Facing World Foundrymen

EARNESTNESS with which foundrymen of the world are facing their problems of production, the zeal with which the technical branches of the industry are pursuing metallurgical science, and the sturdy spirit of cooperation which is peculiar to the foundry world and which knows no national boundaries, were exemplified in all the sessions of the Third International Foundrymen's congress in London during the week of June 10. The cordial hospitality of the Institute of British Foundrymen and the respect in which that organization is held in its native land were shown in every public function.

The opening meeting of The Congress held in the grand council chamber of the Guildhall of London represented a distinct compliment to the institute and the foundrymen from many lands. With all the pageantry of which the city is capable, it threw open that ancient edifice to welcome the hundreds of delegates to the congress.

The technical sessions were characterized by lively and timely discussion. Those papers which had been prepared in advance were amplified and their points supported or argued upon by carefully-prepared written discussions. The comment from the floor was argumentative without being acrimonious; dignified, but consistent, and at all times was characterized by keen desire to seek out the truth.

The arrangements made by the local branches of the institute provided many interesting plant visitations, and their hospitality, coupled with that of the Foundry Trades' Equipment and Supplies Association, Ltd., and the conference committee, provided many features unexcelled in previous international gatherings of foundrymen.

Pagentry Attends Opening Session

FLANKED by his sword and mace bearers, the Lord Mayor, Sir Kynaston Studd, officially opened the Third International Foundrymen's congress at 10 a.m. on Tuesday, June 11, in the grand council chamber of the ancient and beautiful Guildhall of the city of London.

Following the Lord Mayor's greeting, with Wesley Lambert, president of the Institute of British Foundrymen, in the chair, a gold medal was presented to Prof. Thomas Turner, of Birmingham university, in recognition of his unusually distinguished achievements on behalf of the foundry industry of the whole world. The Oliver Stubbs gold medal, awarded annually by the Institute of British Foundrymen, then was bestowed on President Wesley Lambert.

Joining in the applause which greeted this popular announcement, were the presidents or chief representatives of the foundrymen's associations of eleven great countries.

Welcomes Delegates

THE city of London showed exceptional courtesies to the foreign delegates in permitting the use of the ancient Guildhall for the reception held Tuesday afternoon. This reception was on the invitation of Sir John Dewrance, who was assisted in receiving by President and Mrs. Wesley Lambert. More than 300 members of the overseas delegation and of the Institute of British Foundrymen were present.

These gentlemen were introduced by T. Makemson, general secretary, Institute of British Foundrymen. Each one in responding expressed his appreciation of the great importance of these recurrent international foundrymen's meetings. All agreed that the success of the International Foundrymen's congress idea now was assured.

Among those who were presented were: S. T. Johnston, president, American Foundrymen's association; E. V. Ronceray, representing the Association Technique de Fonderie de France; Siegfried G. Werner, representing the allied German foundrymen's associations; Carlo Vanzetti, representing the Italian foundrymen; Marcel Remy, from Belgium; Mr. Buzek, Poland; Mr. Stoffell, Holland; Mr. Bacher, Czecho-Slovakia; Mr. Hess, Denmark; Mr. Brasseur, Luxemburg; Mr. Masburger, Spain. In addition to the officials of the various foundrymen's associations mentioned numerous other prominent foundrymen were present from all parts of the world.

In a masterly address, Wesley Lambert, president, Institute of British Foundrymen, traced the evolution of the foundry industry during the past

several decades in Great Britain, France, Germany, Belgium, Italy, Spain, the United States and other countries. He touched on all phases of the industry in his address, which, in fact, constituted a broad and accurate survey of world foundry progress. Mr. Lambert indicated that progress is the product of general cooperation. "Science, art, industry and craftsmanship," he said in conclusion, "know no national frontiers."

Report on Test Methods

The report of the test bar committee of the Institute of British Foundrymen was presented by the chairman, John Shaw. This report explains the British position toward shear tests made from samples trepanned from the casting by a hollow drill. The committee being of the opinion that no constant ratio exists between the shear test value and the tensile test value of the cast irons of commerce, it was suggested that the adoption of the proposed Fremont shear test for commercial specifications be deferred in Great Britain.

In the absence of the author, the American exchange paper: "Some Interrelationships in Gray Iron Metallurgy," by J. W. Bolton, the Lunkenheimer Co., Cincinnati, published in the June 15 and July 1 issues in THE FOUNDRY, was read by Dan M. Avey, Editor of THE FOUNDRY and vice chairman of the papers committee of the American Foundrymen's association. Opening the discussion, R. S. MacPherran, Allis-Chalmers Mfg. Co., Milwaukee, pointed out that Mr. Bolton's paper constitutes an important progress report on a problem which metallurgical leaders in the American foundry industry now are working on for the purpose, if possible, of establishing a definite correlation between the test bar and the casting it is supposed to represent. The importance of the subject was emphasized by R. F. Harrington, Hunt-Spiller Mfg. Corp., Boston. Mr. Harrington suggested that further experience with larger test specimens might yield further information.

Discuss Exchange Paper

Opening the discussion on behalf of members of the Institute of British Foundrymen, Prof. Thomas Turner, Birmingham university, said the paper reflects the considerable advance which Mr. Bolton has made toward the solution of the problem of correlating the bulk and surface of castings. Professor Turner agreed that in analyzing the qualities of castings, it is not sufficient merely to summarize the silicon carbon relationships, although British foundrymen think this is an important phase of the problem. Control of the amount and form of graphite as recommended by the author, he said, is more important than dealing with the matrix.

Others Comment

J. G. Pearce, director, British Cast Iron Research association, Birmingham, discussed the paper. Others who commented included J. E. Fletcher, also affiliated with the Cast Iron Research association; William Jolley, Metropolitan-Vickers Electrical Co., Ltd., Manchester; John Shaw and James T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala. Mr. Fletcher pointed out that foundrymen should go back to the origin of castings and study the effect of blast-furnace practice on the characteristics of cast iron.

E. V. Ronceray, Bonvillain et Ronceray, Choisy-le-Roi, near Paris, said that Mr. Bolton's work appears to confirm the usefulness of the Fremont-Portevin methods of testing, using a test piece taken from the casting itself. This method of testing, he said, recently has been adopted by the French navy. There is no difficulty, he pointed out, in obtaining a suitable sample from castings.

Investigate Gray Iron Problems

AT THE session on ferrous metals, presided over by F. P. Wilson, Middlesborough, a paper by Prof. E. Dipschlag, Instituts an der Technischer Hochschule, Breslau, Germany, which was held over from the opening session, was read by the author. This paper dealt with the influence of graphite in pig iron on the resultant properties of castings.

The paper presented on behalf of the Polish foundrymen's association by K. Gierdziejewski was read in abstract. In commenting upon this paper, F. J. Cook, Birmingham, stated that he holds no harmful effect may be expected from sulphur, unless that element appears in excess. The important factor is the relation of sulphur to silicon. J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala., holds that the sulphur problem is acute in pipe work, and that sulphur in the amount of one-tenth of the total silicon results in a manganese sulphide if the iron is poured hot, or blowholes if it is poured cold.

The next group of three papers referred to the effects of the three elements chromium, manganese and nickel, upon cast iron.

In his paper on "The Influence of Chromium in Cast Iron," J. W. Donaldson, Scott's Shipbuilding & Engineering Co. Ltd., Greenock, stated

Representatives from the Leading Foundrymen's Organizations Throughout the World Attended the

that chromium up to 0.9 per cent increases the stability of the combined carbon at temperatures up to 550 degrees Cent. Better heat-resisting irons are obtained, but difficulty is experienced in machining where chromium is in excess of 0.4 per cent. Small additions of chromium reduce the corrosion of cast iron slightly.

Effect of Manganese

A. L. Norbury, Birmingham, presented some interesting considerations on the influence of manganese on gray iron. He stated that lowering the manganese content below 0.3 per cent is equivalent to introducing a hard brittle constituent, but the tensile and transverse strengths are not affected in pearlitic irons. Gray cast iron which contains only traces of sulphur and manganese has abnormally high combined carbon content. Increasing the manganese up to 0.3 per cent reduces the combined carbon to normal. The normal action of manganese is to stabilize iron-carbide and to increase the tendency of the metal to chill more readily.

Arthur B. Everest, Bureau of Information on Nickel, Ltd., London, stated that the action of nickel leads to material improvement in the production of high-quality cast iron, and expedites machining operations. The author holds that this improvement is due, in part, to the equalization of structure brought about by the nickel in reducing the chilling effect, permitting the use of higher silicon irons.

In the discussion which followed the papers on effects of alloys of nickel, manganese and chromium, a few differences of opinion were developed. H. Field, Wolverhampton, questioned whether the application of nickel is not perhaps limited to high-silicon irons. With reference to the influence of manganese, Mr. Field believes that the shrinkage varies greatly under influence of manganese, depending upon other factors in the analysis of the iron. R. S. MacPherran, Allis-Chalmers Co., Milwaukee, stated that his shop uses from ½ to 1 per cent nickel in the ladle to increase machinability, with the result that the nickel-iron is more easily machined by the ratio of 2 to 1. He found that by lowering the phosphorus content below 0.20, a marked decrease in shrinkage was obtained.

Promotes Uniformity

R. F. Harrington, Hunt-Spiller Mfg. Co., Boston, said that nickel in many instances is valuable, in that it promotes uniformity of structure and permits the use of fewer mixtures for a great variety of castings. However, he does not believe that nickel is a cure-all for all difficulties. John Shaw, Southsea, stated that over 0.4 per cent manganese produces a chill. H. J. Young, London, questioned whether it was necessary to have manganese greater than 0.2 per cent higher than that necessary to produce manganese-sulphide. F. J. Cook commented that, in his opinion, the ratio of the elements is the important factor for consideration in the use of various alloys.

Tests Effects of Coal in Facings

KEEN interest in the practical problems of foundry practice was evidenced by an exceptionally large attendance at the general session Thursday morning, June 13. The Belgian exchange paper on vocational training was read by title. Similarly the Dutch exchange paper on foundry molding sand, by H. Van Aarst, in the absence of the author also was presented by title. The paper on coal dust as applied to molding practice, by Ben Hird, Upper Cwmbran, Wales, was presented in abstract by the author. Mr. Hird carried on some unusual experiments on the use of coal dust, varying the proportion of dust and the fineness of the grist in an attempt to induce common surface defects which are accredited to the use of this material in facing sand mixtures. He determined from his experience that pockmarks, slight surface indentations, are due to coarse coal dust.

Ratching, a term applied to small eruptions on the casting-skin which require filing, or chipping, similarly is ascribed to coarse coal dust.

Another defect, known as mapping, results when an excess amount of fine, high-volatile coal dust is used in the facing sand. When the molten iron is poured into the mold, the fine specks of coal, thoroughly intermixed with the sand, give off volatile matter and change to small beads of coke. This change, which takes place instantly, causes the specks of coal to swell, expanding the skin of the mold, so that it buckles inward, and cracks. The molten iron then enters these cracks, forming fins of irregular shape running along the face of the casting.

Mr. Hird experimented first with thin plates in arriving at the results studied. Next he made cylinders, the quadrant faces of which were made from four different mixtures in an effort to get a comparison relieved of all variables except those arbitrarily applied in making different facing mixtures. An original and entirely untried method of studying reaction within the mold has been developed by the writer of this paper. He has

Opening Meeting of the Third International Foundrymen's Congress in the Famous Guildhall, London

made molds into which are set small windows of mica. Looking through as the metal is poured into the mold, the writer has found that the entering iron assumes a convex form as it rises in the mold, the outer edges being held back while the metal rises. In the meantime a film of smoke advances ahead of the entering iron, and this smoke is credited by the author with supplying the surface coating, which results in the fine blue appearance of the casting made from a mold in which the proper proportion and quality of coal dust is used. He found that mapping is not experienced when coal dust of a fine, highly-volatile nature is used in proportions of from 0.5 to 1.5 of coal dust to 10 of sand.

Expresses Views

W. J. Cook, Birmingham, questioned whether pockmarking resulted entirely from coal dust in the facing. He believes that an excess of binder, such as that which results when sand is sieved and then a portion is rubbed through the sieve, may produce spots, which swell and cause surface depressions. In the case of mapping, Mr. Cook holds that the mold surface breaks by contraction and not by expansion, and cites as his evidence in support the irregular patterns formed on the face of a mold which is baked and afterwards must be blacked to fill the surface cracks before the mold is poured.

H. B. Hanley, Rochester, N. Y., commented favorably upon the author's attack on this problem of foundry practice. He ascribes pockmarks to balling up an excess of binder. He mentioned the difference in fineness and analysis of American facing coal, and stated his belief that unnecessarily fine coal dust may reduce permeability materially. J. G. A. Skerl, Sheffield, called attention to the fact that the author had used coal dust which was coarser in the various grades than that supplied commercially by manufacturers of that material.

Questions Use of Sea Coal

James M. Primrose, Falkirk, Scotland, advanced the question as to whether coal dust ever is advisable, since it reduces the desired bond, forms gas, and reduces the permeability, all of which are undesirable features. S. H. Russell, Leicester, stated his belief that coking causes the troubles outlined by Mr. Hird. He has found that mapping may be the result of pressure of the metal forcing fins into sand in which the bond has been weakened. H. Winterton, Dumbartonshire, representing a manufacturer of coal dust or sea coal facings, defined superfine dust as that material of which 90 per cent will pass a 110 mesh sieve.

A paper on "Application of Pulverized Coal to Metallurgical Furnaces" was read by E. C. Lowndes, co-author with H. W. Holland. This paper defined the two main divisions of powdered coal as the bin-and-feeder system or the direct-fired. It represented the advantages of the former method and the disadvantages of the latter. The examples cited in the paper concerned mainly the application of this fuel to the billet furnaces and to malleable iron practice.

Meet Again

THE third annual reunion of the Club Lancastria, so designated from the name of the ship upon which a party of overseas foundrymen journeyed to America in 1926, was held at the Hotel Cecil, London, on Tuesday, June 11. In addition to the members of the club, a small number of guests from among the American delegates attending the conference in London experienced the pleasure of renewing old acquaintances. Those present included the following: from England: Mr. and Mrs. Frank Russell, W. B. Lake, Mr. and Mrs. William Jolley, A. C. Turner and Vincent Delport; from Scotland, Mr. and Mrs. Harry Winterton, Mr. and Mrs. W. D. Campbell, John Cameron and James W. Primrose; from France: E. V. Ronceray and H. Magdalenat; from Italy: Mr. Carlo Vanzetti, Miss Vanzetti, and Antonio Galtarossa; from America: S. T. Johnston, S. Wells Utley, H. Cole Estep and Dan M. Avey. Frank Russell, Sheffield, presided.

Present Data on Test Methods

TWO sessions held on the morning of Thursday, June 13, one was devoted almost entirely to a discussion on cast-iron testing methods. This followed from the presentation of the exchange paper of the Association Technique de Fonderie de Paris entitled "Cast Iron Testing Methods," by M. Le Thomas and M. Bois, a paper by J. G. Pearce, director of the British Cast Iron Research association on "The Influence of Size of Section on the Strength of Gray Cast Iron," and a "Report on the Shear Test for Cast Iron," by the test bar committee of the Institute of British Foundrymen. These papers and the report dealt with methods recommended by the respective test-bar committees of the French and British technical associations. The French investigators recommend the shear test and the static-transverse test with the use of small test pieces trepanned from the casting itself, the method being known as the Fremont test. The British have adopted standard specifications defining dimensions of three test bars cast from the same metal at the same time as the casting. One or the other of these test bars is used according to the thickness of the casting.

Lack Requirements

Expert investigators from Great Britain, France, Belgium and the United States contributed to the discussion, the underlying idea of which was that no test as yet answers the requirements of the industry. It is generally agreed that a test bar cast apart, even from the same metal and at the same time as the casting, does not represent the quality of the casting itself, but only defines the characteristics of the metal that goes into it. It is also agreed that it is desirable that a test should be found that will enable the engineer to obtain an idea of the qualities of the casting itself. It is for this purpose that the French have put forward the Fremont tests. However, certain objections are made to this test by other investigators. In closing the discussion, Wesley Lambert, who was presiding, said the smaller the test piece is, the more difficult it is to obtain good results. It is unfortunately impossible in most cases to get a specimen large enough to give reliable results without destroying the casting.

In the course of the discussion, a representative of the Polish foundry industry stated that the Polish foundrymen are directing their attention to finding a new shock test

which should not be open to the objections that prevail with respect to the shock tests now in use.

A paper on "The Critical Examination of Steel Castings" was presented by G. F. Gillott, this paper being a communication from the research department, Woolwich. The author dealt with the examination of steel castings by X-ray apparatus, and with the macroscopic and microscopic examinations. He showed how flaws can be detected by radiographs, but pointed out that it is still more important to know the source of a defect, which can be obtained by macrography, micrography, chemical analysis and hardness testing.

Study Nonferrous Structures

THE session dealing with nonferrous metals was held under the chairmanship of Wesley Lambert. The first paper to be presented was entitled: "Practical Points from the Metallurgy of Cast Bronzes," by H. C. Dews, Dewrance & Co., London. The author endeavored to familiarize the practical foundrymen with some of the difficulties met in bronze foundry practice, and emphasized the necessity of trying to overcome the porosity of bronze, which is due to two peculiarities of the freezing. In the first place bronze freezes over a range of temperature, and, secondly, it contracts in volume.

Study Solidification

A. H. Mundey, Fry's Metal Foundries, Ltd., London, expressed interest in Mr. Dews' remarks on the mechanism of solidification. He stated that the phenomenon may be studied closely in some alloys that solidify at the lower temperatures.

A. Logan of R. & W. Hawthorn, Leslie & Co. Ltd., Newcastle, said that it was necessary to know more about contraction during freezing than to carry on further investigations in that direction. One member inquired about the formation of tin sweat on the risers in the casting of bronze with 10 per cent tin. Mr. Dews replied that in light castings with heavy runners this occurrence should not cause any worry, but in heavy castings the appearance of this sweat generally indicates that the casting is defective.

The previous speaker also stated that in certain bronze bearings with 8 to 10 per cent lead, one often encounters the formation of slag, and inquired whether it is possible to get rid of this slag. Mr. Dews replied that the addition of 8 per cent lead to the alloy would always give slag which forms all the time and is exceedingly liquid. In a high lead phosphor bronze the best method is to cast with a good strainer head, to have a substantial amount of metal in the runner. The addition of nickel will not eliminate the slag, and there is no way in which to get rid of it.

Replying to another question as to whether fracture or physical tests constitute the best guide to examining a casting, Mr. Dews said that much may be said in favor of the fracture alone. To obtain satisfactory results from physical tests one must cast six or eight test bars, including bars cast at a higher temperature and others at a lower temperature than the required casting temperature. Then the tensile strength of each of these bars should be plotted on curves. However, this is hardly a practical test in ordinary foundry practice, whereas the examination of the fracture is a very simple method. However, it is necessary to have acquired a good deal of experience in interpreting the fracture.

WESLEY LAMBERT, recently installed as president of the Institute of British Foundrymen, is a nonferrous metallurgist of wide repute. He was educated at Roan school, Greenwich, and at Kings college, London. In 1890, he was appointed assistant metallurgist at the Royal gun factory, Woolwich, and in 1894 was metallurgist and lecturer on engineering chemistry at the Ottoman naval arsenal. In 1901, Mr. Lambert became chief metallurgist at the Royal gun factory, Woolwich where he received a treasury award for special services. At one time, he was special lecturer at the Sir John Cass Technical institute. Mr. Lambert has presented many papers at conventions and is a contributor to the technical press. He is a member of many societies among which are: Institute of British Foundrymen, British Engineering Standards association, Institute of Civil Engineers, Institute of Naval Architects, Institute of Marine Engineers, British Institute of Metals and the American Society for Testing Materials. He now is employed as manager of the metallurgical department of J. Stone & Co. Ltd., Deptford and Charlton, London. Mr. Lambert is a past president of the London branch of the Institute of British Foundrymen, and was senior vice president of the Institute of British Foundrymen.

Tin Solidifies Last

Mr. Logan stated that tin is the last constituent to solidify, and it is necessary to cast as nearly as possible at a temperature where this constituent will be trapped in the casting. With regard to the 10 per cent lead alloy, he said that it is not necessary to exceed a certain content of phosphorus, and that usually the metal contains too much phosphorus.

The use of nickel is of most interest with alloys containing from 25 to 30 per cent lead, as the presence of the nickel prevents segregation of the lead. Mr. Logan, referring to a passage in Mr. Dews' paper where it is stated that there are no soluble oxides in bronze, remarked that many castings made with borings or other bronze scrap are not good. If this is not due to oxidation, what is the remedy? Mr. Dews replied that if the remelting is properly effected, the casting should be good. Oxides are insoluble, and the casting should be conducted in such a way that all insoluble oxides should come to the top, and be skimmed off.

A. H. Mundey contributed a paper on "Die Casting," which gives a comprehensive description of the processes now used. Replying to a question as to the solubility of aluminum in cast iron pots, Mr. Mundey said that steel pots are used. Wesley Lambert mentioned a pressure die-casting machine which he recently had seen in Germany and which he briefly described as consisting of a rectangular box set over the pot of metal. The box is lowered into the

metal bath and fills itself; it then is lifted and swung between two plates. Air is applied in the box and forces the metal out into the mold through an aperture in one of the plates. Examples of castings made in a plunger pressure die-casting machine were exhibited.

The session ended with a paper entitled: "Crystalline Grains in Castings," and presented by Ing. Dr. A. Glazunov, professor at the school of mines, Pribram, Czechoslovakia. Opening the discussion on this paper, Mr. Lambert emphasized the fact that a crystalline grain fracture does not necessarily mean that a casting is not good. It often is said that a metal crystallizes through fatigue. This, according to the speaker's opinion, is ridiculous, and if fatigue had any effect it would be to reduce the size of the crystals. T. H. Turner of Birmingham stated that it has been possible to reduce the size of crystals in nonferrous castings, particularly in the 13 per cent silicon alloy, and that recently it also has been found possible to reduce the size of the grain in cast iron.

Praises World Foundry Movement

THE annual banquet of the International Foundrymen's congress marked the climax of a long chain of interesting experiences for the delegates to the third International Foundrymen's congress. More than 500 were in attendance at this function, where Wesley Lambert, president of the Institute of British Foundrymen, presided.

In proposing the toast to the Institute of British Foundrymen and its president, Sir John Dewrance spoke of the influence of common scientific interest upon international peace. In response, President Lambert spoke of the pre-eminent value of the interchange of information along technical lines and paid tribute to the attainments of British foundrymen. He extended courtesies to all those individuals and organizations who contributed to the success of the congress and the enjoyment of those who made the preconvention tour.

Must Study Conditions

S. H. Russell, retiring president of the Institute of British Foundrymen, spoke of the necessity which faces foundrymen in that they must learn new methods, study new materials, and perhaps alter the character of their product to meet modern competitive conditions.

In his response, S. T. Johnston, president of the American Foundrymen's association, spoke allegorically of the eight gates to the castle of British hospitality typified by the various points visited during the preconvention tour and the final entry to the inner chamber of the castle typified by the banquet. He presented an illuminated copy of the resolutions drafted at the recent Chicago convention of the American Foundrymen's association extending greetings to the international congress.

Sir Joseph Petavel, director of the National Physical laboratory, commended the foundry industry as an outgrowth of the earliest known craft. He referred to the fact that until comparatively recent days the foundry art has been a seat of mystery, but that science today has thrown wide the doors, and that the time for secrets at last has passed away.

Reports Progress in Research

ON MONDAY, June 10, the twenty-sixth annual general meeting of the Institute of British Foundrymen was held in the hall of the Institution of Mechanical Engineers at 8 p.m. In the annual report it was stated that the year has been one of steady progress, and the number of members increased from 1729 in 1928 to 1776 this year, a gain of 47.

Educational Work Continues

A step forward has been taken in connection with the scheme for a national certificate in foundry practice, for the benefit of students attending day or evening classes in these subjects. The institute's own educational work has been continued through the activities of the five junior sections, all of which have completed successful sessions. The work of the junior sections has been stimulated by the establishment of the Buchanan medals to be given for essays giving a resume of the session's work of the junior section to which the candidate belongs.

New I. B. F. Officers

President
WESLEY LAMBERT
Chief Metallurgist, J. Stone & Co., Deptford, London.

Senior Vice President
F. P. WILSON
Pease & Partners, Middlesbrough.

Junior Vice President
A. HARLEY
Foundry Manager, Daimler Co., Coventry.

Members of Council
J. Haigh, Lancashire branch.
W. T. Evans, East Midland branch.
H. Winterton, Scottish branch.
D. H. Wood, Birmingham branch.
A. Firth, Sheffield branch

Honorary Treasurer
F. W. FINCH
Birmingham branch

Trustees
F. J. COOK
R. O. PATTERSON
O. STUBBS.

Referring to the work of the test bar committee set up by the institute, the report points out that hundreds of tests have been made, the cost of which under ordinary conditions would considerably exceed $5000. However, the work has been done without cost to the institute, through the co-operation of the members of the test bar committee and the firms with which they are associated.

Research Progress

Reference was made to the work of the British Cast Iron Research association, whose activities have progressed on normal lines during the year. The work done during the year has carried a number of developments a stage further from the purely metallurgical side, and several advances of great interest have been made. Developments refer to the influence of manganese in relation to sulphur, relationships between structure and composition, alloy cast irons, heat resisting irons and malleable iron.

Work on molding sands has reached a point at which particulars have been placed before members of simple foundry control tests, which will enable sand conditions to be related to

troubles experienced, and to enable a minimum of new sand to be employed consistent with safety. Developments of an important character with respect to the cupola also have been made by J. E. Fletcher.

Following the reading of the report, Wesley Lambert, chief metallurgist, J. Stone & Co., Ltd., London, was elected president of the Institute of British Foundrymen for the year 1929-30.

International Committee Elects Officers

The Foundrymen's International committee, which consists of representatives of the leading foundry organizations of Europe and America, met at the Hotel Cecil, London, on Tuesday evening, June 11, with S. T. Johnston, president of the committee, in the chair. T. Makemson, secretary, also officiated.

In opening the meeting, Mr. Johnston expressed his pleasure in being able to convene such an important body, the Foundrymen's International committee constituting in itself tangible evidence of the great progress which is being made toward international co-operation.

Regret was expressed at the absence of Paul Ropsy, of Belgium, who was the first president of the committee and one of its principal organizers.

A motion was passed unanimously stating that in the opinion of the committee every effort should continue to be made by the associations concerned to maintain and perpetuate the high quality of the international exchange papers, which now are a feature of many foundry conventions.

It was agreed that the triennial international meetings, of which the present one in London is the third, should be officially designated "International Foundrymen's congress," with the proper numerical prefix, the next one, in 1932 in Dusseldorf, in accordance with this, to be known in English as the Fourth International Foundrymen's congress.

After disposing of other items of business, the committee proceeded to the election of officers for 1930. Carlo Vanzetti, who represents the Italian foundrymen on the committee, was unanimously chosen president. It also was unanimously agreed that the president of the Association Technique de Fonderie de France in 1930 shall also be vice president of the International committee. T. Makemson, general secretary of the Institute of British Foundrymen, Manchester, was unanimously re-elected secretary of the committee. After the election, the committee adjourned.

Special Luncheon Given Overseas Delegates

F. W. Bridges & Sons, Ltd., managers of the exhibition, tendered a luncheon to the overseas delegates to the International Foundrymen's congress at the exhibition hall on Thursday, June 13. H. Winterton, Glasgow, president of the Foundry Trades' Equipment and Supplies Association, Ltd., occupied the chair. Wesley Lambert, president, I.B.F., welcomed the guests with appropriate remarks. Responses expressing the appreciation of the various foreign delegates for the splendid reception accorded them were made by Fred Erb, vice president, A.F.A., Dr. Siegfried Werner, Dusseldorf, representing the allied German foundry associations, and E. V. Ronceray, Paris, representing the Association Technique de Fonderie de France. The toast to the chairman was proposed by F. P. Wilson, senior vice president, I.B.F. In his response, Mr. Winterton touched on the mutuality of interest existing between the foundry industry and the foundry equipment and supply manufacturers. After the luncheon the official visit to the exhibition took place.

Steel Founders' Society Meets

A NEW consciousness of their industry came to members of the Steel Founders' Society of America at their midsummer meeting, June 27-28, at White Sulphur Springs, W. Va. With this new consciousness also came a broader appreciation of the advantages of attacking the problems of their industry as a group, rather than as individuals.

Thursday morning, June 27, the steel foundry executives listened to an address by Homer J. Buckley, president, Buckley, Dement & Co., Chicago, direct mail and merchandising specialists. Mr. Buckley told the attending members that selling will be their major problem during the next decade; that steel foundries will have to guard against competing products; and that they must work collectively to strengthen their organization under capable leadership.

Steel foundries, he pointed out, are a source of essential service to industry. Through friendly competition, he believes, they may work to become an indispensible factor in the success of their customers, making progress in this respect impossible to achieve when bitter rivalries, complacency and jealousies prevail.

After being introduced by President John E. McCauley, Birdsboro Foundry & Machine Co., Birdsboro, Pa., the new secretary of the organization, Granville P. Rogers, briefly discussed his plans for undertaking and enlarging the work of the society. The secretary plans a three-month survey of the industry. Upon the facts revealed in this survey will be based a plan of operation which will be brought before the executive committee early in the fall.

Open New Offices

New offices of the society, Mr. Rogers announced, have been opened at room 932, Graybar building, New York.

During the course of the two-day meeting, A. H. Jameson, Malleable Iron Fittings Co., Branford, Conn., told of activities of the American Society for Testing Materials affecting steel castings producers. Mr. Jameson, who had attended the Atlantic City meetings of that organization before coming to White Sulphur Springs, told of the passing by committee A-1 of the report on valves, flanges, and fittings for high-temperatures permitting the use of only electric and open-hearth steel, and excluding bessemer steel.

He warned members of the Founders' society against what he sensed as a tendency toward the exclusive use of electric steel for these parts and suggested that the situation be considered seriously by the executive committee. J. E. Galvin, Ohio Steel Foundry, Lima, O., suggested that the new high-speed cutting steels which are being introduced might cause machine tool designers to specify steel castings to gain additional strength and rigidity required to meet the stresses and strains imposed by the use of these new cutting tools. Mr. Galvin also reviewed some of the expenses thrust upon steel foundries by customers who leave inactive patterns with foundries for indefinite periods. In his estimation, foundries should not be responsible for patterns that have been inactive for two years or longer.

Producing Steel Castings in the Modern Foundry

Part IV

By Charles W. Veach

AFTER a campaign of 500 heats the furnace was rebuilt and Fig. 10 shows the condition of the jambs after nearly 500 heats were tapped. The banks of chrome ore which protected the jambs are still intact, and it is apparent that another 100 heats could have been made on them if the checkers had not clogged which necessitated shutting down the furnace. The back wall and the slopes from the ends of the bath to the uptakes were protected in the same manner as the door jambs.

Fig. 11 shows the interior of a furnace rebuilt after a campaign. The slanting section at the back is the slope leading from the bath to the uptakes. The two division walls which may be seen near the center of the back wall divide the uptakes. These and the slope are covered with one course of chrome and magnesite brick. The front and back walls are made 4½ inches heavier from the bath to the end of the furnace, than the walls are across the bath. This was done so that this part of the walls would not require repairing during a furnace campaign. The extra thickness reaches to within about a foot from the skew back. Above this point less erosion occurs than lower down where the waste gases come in contact with the lining.

Absence of obstructions in the way of escaping gases also is shown in Fig. 11. Since the brickwork of the slope is covered to a depth of 3 inches with chrome ore when the furnace is fired up, little wear occurs and little labor is required to keep this part of the furnace in repair. The burner extends through the square opening in the center of the wall, and across the center uptake. This permits the incoming air to rise above the gasified fuel and then sink into it and function properly in combustion. The burner is mounted at an angle which conforms with that of the slope, and delivers the flame so that it strikes the bath only a few feet away from the slag line. The incoming air at the uptakes assists materially in deflecting the flame from the roof.

The exterior view of the furnace shown in Fig. 12 is presented to show the unusual length of the burner chamber. The only advantage in this construction is in the high flame temperature which develops before the flame reaches the bath. Although the question of efficiency between the long flame and the short one has been discussed considerably by open-hearth superintendents during recent months, it has not been settled yet. With the construction shown, the advantages of both the long and short flames may be had because the flame has sufficient volume to cover the bath without combustion taking place at the outgoing end of the furnace.

Basic open-hearth charges consist of about 40 per cent pig iron, and 60 per cent scrap. The amount of limestone used depends on the amount of sulphur and phosphorus to be eliminated, and varies from

Selects Raw Materials

CAREFUL selection of scrap, pig iron, and limestone is important if a good product is expected, and in this article the author gives some pointers on the different classes of desirable material. He also describes the arrangement of a stockyard suitable for containing materials for supplying five 35-ton furnaces. The author discusses the advisability of substituting cheap refractories for reliable materials on a first cost basis, and shows that it is not a good method of comparison.

FIG. 10—VIEW OF THE DOOR JAMS AFTER A CAMPAIGN OF NEARLY 500 HEATS. FIG. 11—INTERIOR OF THE SAME FURNACE AFTER REBUILDING WALLS AND ROOF

about 10 per cent of the metal charge to as high as 15 per cent. Acid open-hearth charges consist of about 20 per cent pig iron and 80 per cent scrap. No lime is used. A typical basic pig iron contains 1.75 per cent manganese; 1.00 per cent silicon; 0.035 per cent sulphur; 0.125 to 0.2 per cent phosphorus, and 3.50 to 4.00 per cent carbon. A typical acid pig iron contains 1.00 per cent manganese; 0.75 to 2.50 per cent silicon; 0.045 per cent sulphur; 0.045 per cent phosphorus, and 3.50 to 4.00 per cent carbon.

Must Make Good Slag

Simply confining a charge of pig iron and scrap steel within the confines of a basic or acid open-hearth bottom and applying heat to the mass until it is melted and superheated is only part of the operation. Regardless of the process used, making the proper kind of slag is the sum total of the operation. With a good slag other conditions will be right, but if the slag is bad the product will be inferior and probably more costly than otherwise. Therefore, it is of prime importance to have a balanced charge.

A balanced charge is one which will melt with just sufficient carbon to take care of any iron oxide in the bath, entrapped in the slag, and the small amount formed during the refining period. However, a balanced charge cannot be had unless the scrap is bought and stored with this in view.

No price differential obtains, even where foundries are isolated, that is sufficient to justify buying an inferior grade material for use in steel castings. The yield obtained with other advantages justifies purchasing the best that the market affords. Since the automobile industry has attained its present importance and added several grades of scrap to the list there are almost 50 separate grades of scrap on the market. Of this large number three classes with their subdivisions are sufficient for the steel-foundry, purchasing agent to make a selection. These three classes are high carbon, medium carbon, and low carbon scrap. Their value for use in open-hearth charges is in the order they are given, but this depends also on the thickness of the section, and on the freedom from rust or lead paint.

High carbon steel scrap—class A includes rails, springs, tire rims, car wheels, etc. The carbon running from 0.50 to 0.85 per cent. Medium carbon—class B includes railroad castings such as bolsters, side frames, draft arms, draw bars, couplers and knuckles, axles, plow beams (not rusted badly), miscellaneous castings and shapes of heavy section, structural material of heavy section, etc. Low carbon—class C includes shearings, punchings, splice bars, built-up bolsters, etc. Extreme care should be exercised in the amount and kind of low carbon scrap that is purchased. Enough may be kept on hand so that the stock weigher can use a predetermined portion on each heat. Light scrap, or scrap that is badly rusted should be used sparingly or not at all.

To make two tons of castings one gross ton of pig iron will have to be bought when the basic process is used, and a ton or a little more scrap will be required, depending upon the furnace loss that prevails. Melting loss will be governed by the amount of impurities in the charge, the limestone burden (in basic practice), and melting practice. Considerable loss may result from bad bottoms, and even a greater loss may result from sloppy pouring practice. Metal so lost is not recoverable.

Material available should permit the stock foreman to make up heats according to Table I or its equivalent. Shop scrap represents defective castings, gates and risers, and will vary in amount depending on the kind of product made as well as conditions existing in the shop. The object must be to keep this item as low as possible. As the shop scrap is high quality material, class B should be substituted for it when it is not available.

It is best to have the raw materials stored under roof, for when the weather is inclement, especially when there is heavy snow fall, making up heats is a difficult job. Charging material that is wet or covered with snow and ice, should be avoided. Charging wet limestone has been the cause of blowing a hole in the roof of a basic furnace and excess moisture is not good for a basic bottom. If housing cannot be provided, the next best arrangement is to have a yard of such dimensions that it can be divided into two or more sections for each kind of material carried in stock. The sections should be large enough to prevent material overlapping and it should be wide enough for loading and unloading tracks to parallel the crane runway.

One such yard for the storage of raw materials is 1800 feet long and 72 feet wide. This is just ample to take care of the stock for five furnaces of 35 tons capacity. The yard is divided into 18 sections. Each section is a little less than 100 feet long so that a space is available in which the rail breaking press is located. The sections are numbered and when material is unloaded, or loaded in charging cars, it is shown on the stock record what section received it or from which it was withdrawn. This facilitates the keeping of stock records, and makes it possible to have instant inventory.

Fig. 12—Exterior of Furnace Showing Long Combustion Chamber

One section is allotted to rails which are charging box length. Another is allotted to long rails. The rail breaking press is between these two, and as rails are broken they are moved to a place in the section for short rails, or loaded directly into charging boxes. A section is available for each class of heavy melting scrap, and sufficient space is available so that if several cars of scrap are received coming under the general head of heavy melting, but varying in thickness of section or in any way that would suggest need for segregation, this can be done. Thus a section may be subdivided and the divisions designated by letter if desired. By consulting his record the foreman can tell how many tons of each kind of material is on hand. The purchasing agent then knows what classes of scrap are short and what classes are long, and can regulate his buying accordingly.

At least three sections should be allotted to pig iron. The size of each section will depend on the number of furnaces to be served. If the basic process is used the iron should be graded according to the amount of manganese it contains. The manga-

nese will vary from about 1.40 per cent to well over 2.00 per cent, but should average about 1.80 per cent. If this is the average manganese content, charges should contain as near this amount of manganese as possible. There is but one way to accomplish this and that is to segregate the iron as it is received after determining its manganese by analysis.

When an order is placed for 10,000 tons of iron, and 1.80 per cent manganese is specified, three-fifths of the order may run from 1.70 to 1.90 per cent; one-fifth will be under 1.70 per cent, and one-fifth above 1.90 per cent. The shipping schedule also may be arranged so that three-fifths of the order can be unloaded direct from the cars into the charges. Thus the expense of double handling is avoided. When the iron is unloaded from the cars to the charging boxes or pans, the manganese first should be determined. If the manganese is in the low range, it should be mixed with a portion of iron in the high range. If no car of high manganese is available the amount required should be drawn from storage. The object is to have manganese in the heats as uniform as possible.

Table I

Calculation of Basic Charge

Material	Weight, Pounds	Per cent
Pig iron	20,000	40
High carbon rails or springs	Class A 8,000	16
High carbon wheels or tires	Class A 3,000	6
Medium carbon	Class B 8,000	16
Low carbon	Class C 4,000	8
Shop scrap	Class B 7,000	14
Total	50,000	100
Limestone	6,000	12

Conforming to the principles thus briefly given, if rigid specifications govern the purchase of limestone, half of the task of making steel already has been accomplished. Limestone used in basic furnaces must be pure, for the slag is obtained from the lime. The operator is interested primarily in making slags, for without good slag he cannot have good steel. Other materials which are used in uniform amounts for the same grade of product are ferrosilicon and other recarburizers. These materials are used in varying amounts, some heats requiring more and some less, while many heats require none at all. In this category are iron ore, fluorspar, 10 per cent silicon pig, and spiegeleisen.

Fluorspar is used mainly to confer fluidity on the slag, but often is indispensable in helping to drain the slag out of the bottom after heats are tapped. Iron ore at all times must be used with discretion. Used with good judgment on a heat which has an excess of carbon it speeds up the operation by eliminating the carbon, confers considerable fluidity to the slag, and adds no extra cost to the product for its iron content is added to the metal bath and goes into the product.

Silicon pig (silicon 10 to 15 per cent) is a necessary adjunct to have in case the carbon in a heat becomes depleted before the heat is shaped up. This condition may arise under the best regulated conditions, for a breakdown may occur somewhere to interrupt the melting operation. The operator may overstep in the use of iron ore, and again occasion may arise which demands the heat to be held unduly long in the furnace. Occasionally a heat will foam without any one being able to determine just what causes it to do so. Silicon pig will clear up a foaming condition and compensate for the loss of heat transfer which it occasioned. However, it is essential to know at what time and the quantity to add, to obtain the best result. Spiegeleisen may be used advantageously in case of a low melt, when the heat is wild, or when it becomes necessary to hold a heat in the furnace. The manganese in the spiegel is more efficacious in removing oxygen from the bath than is silicon, but is less effective in conferring heat to the metal bath than silicon.

If the scientific principles advocated are followed, the occasion rarely will arise where a heat requires doctoring to any extent. However, under the best regulated conditions occasional use of silicon pig or spiegel will be necessary. This is especially so if standard practice demands that at a certain time before tapping the heats a state of equilibrium be attained, and maintained until the metal leaves the furnace. This eliminates the "melt 'em down, get 'em hot, knock 'em out" type of melter, for that practice, if it exists at all, is fruitful of a product whose quality may well be considered as exceedingly doubtful.

Is material purchased on a price basis or on a work factor basis? Also, are the methods of testing accurate and impartial? Unless tests are made by the actual users of materials to bring out the true economic ratio between the one that is in use and another that is being considered as a substitute, the temptation prevails to buy the lowest in price. Many of us have experienced the fact that material, which had passed the usual forms of examination and analysis, did not yield the service expected. On rarer occasions material bought containing a higher content of the element considered most important proved to be totally unsuited for the use for which it was procured.

Applies Protective Material

For the purpose of making clear the principle involved, which may be applied to any material or condition, the author will relate an experience he had with a material specially prepared to protect furnace linings. The special feature of the material is that it can be applied to a hot, perpendicular surface when mixed with water to a consistency that will permit it being applied with a paddle.

A practice of building up a wall of this material to protect the door jambs after they had commenced to show wear was developed. As every open-hearth operator is aware the jambs and the back wall of basic open-hearth furnaces are eroded just above the slag line by the slag splashing. Basic slag coming in contact with silica brick erodes them at a rapid rate. Unless this is prevented the walls cut out below and remain heavy above, until the overhang is so pronounced that it begins to spall and drop down into the bath of metal.

The base of the built up bank rests on the bottom which extends above the slag line. When a heavy bank of material is to be built up from the bottom, special preparation first must be made. The base must be made heavy enough to support the bank of special material, yet not so thick that it encroaches on the bath. The period after heats are melted is a good time to build up the bases preparatory to building the banks of special material to protect the silica walls. If the work is done while working the heat the result is not so good as when the slag is active it washes the refractory away

and it is wasted. Attempting to build up while the furnace is empty is a waste of time and material.

Less than a carload of this particular material which cost $960 a carload was used during a furnace campaign, and the saving made in material and mason labor amounted to $1800 for the campaign. Deducting the cost of the special material used, the actual saving amounted to approximately $1000. This saving was more than the price of the carload of material.

Now suppose that a substitute was tried and performed almost as well as the material it was designed to displace. Unless the difference in the way two materials work is pronounced, the person making the test may hesitate to condemn the lower priced material and make his report favorable to the one costing the most. If he is unable to point definitely to some fault in the substitute material, those anxious to furnish materials at the lowest possible cost may think that his judgment is influenced by his prejudice. However, in this case, when it is considered that the saving made by using the original material amounted to more than its cost, and that the most that would have been saved in the purchasing the substitute material would have been but 60 per cent of the purchase price of the original, there is no incentive to use a substitute for a product which is giving satisfaction.

Moreover, no two materials work exactly alike. They must be handled just a little differently. Even if the head of a department should be able to make efficient use of a material which takes the place of one which costs more and is discarded for that reason, he must train his operators in its use, and this is not always an easy matter.

Pattern Plate Increases Output

By C. J. Morrette

For some time one of our present customers had been dissatisfied with the screens employed in a cement mill stove. These screens were made from rolled steel bars welded together. They were quite expensive and were not hard enough to withstand the severe service to which they were exposed in this particular installation. Called into consultation on the subject, our engineering department decided that a steel casting could be designed and cast from a special alloy steel that would be cheaper and far superior to the fabricated screens then in use.

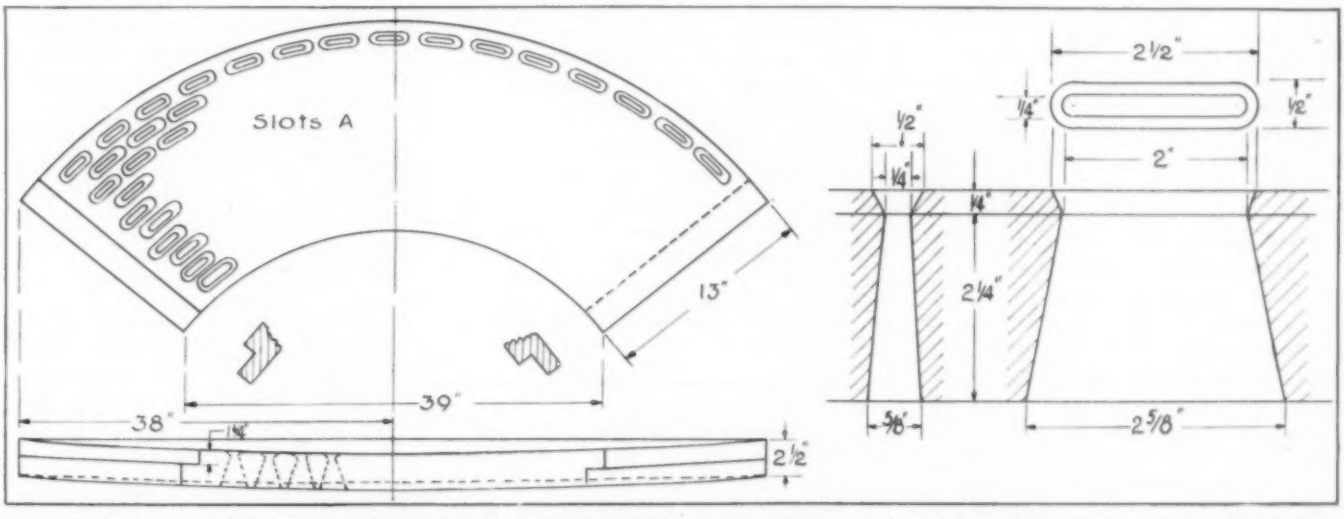
The first experimental castings were molded by hand from a loose pattern. Later when the new screen had proved its worth orders were received for a sufficient quantity to warrant placing the job on a production basis. By hand two men made four castings per day. With a machine and with new pattern equipment two men make from 12 to 14 castings per day. The casting weighs approximately 190 pounds.

An aluminum matchplate was made from the master pattern with the parting as desired in the foundry and as shown in the accompanying illustration. The plate was equipped with ears to engage the flask pins. The plate was made to a good substantial thickness of ⅜-inch to prevent breakage or distortion in service on a jolt machine.

A wood frame then was made equal to the outside dimension of the plate and just high enough to clear the highest point of the pattern on cope and drag and braced beneath to prevent any possible sag during the jolting process. The aluminum plate was bolted to this frame. The bolts and bolt holes were on center lines and interchangeable so that the same holes in the frame answered their purpose when the plate was turned over to make either side of the mold.

Plate and frame were bolted to the table of a jolt, rollover, patterndraw machine and all the drags were made first. The plate then was removed from the frame, turned over, rebolted to the frame and used for making the copes. The pattern leaves its own green sand cores which are not reinforced in any way with nails or wires, striking evidence of the accuracy of the equipment.

Surface Combustion Co., Toledo, O., recently opened a district sales office in Kansas City, Mo. W. H. Kay will be in charge of the office which will be the headquarters for the territory including Kansas, Nebraska, Wyoming, Colorado, Utah, Missouri with the exception of St. Louis and a portion of Texas.



THE ENLARGED SECTION TO THE RIGHT SHOWS THE CHARACTER OF THE TAPERED OPENINGS WHICH WERE SPACED OVER THE PLATE IN STAGGERED ROWS TO THE NUMBER OF 160

A.S.T.M. Studies Cast Iron

Testing Society Considers Various Problems Connected with Both Ferrous and Nonferrous Cast Metals During Annual Meeting at Atlantic City

FOUNDRY problems were given considerable attention at the annual meeting of the American Society for Testing Materials held in Atlantic City, N. J., June 24 to 28. Unusual interest developed in the symposium on the physical properties of cast iron, which was arranged under the direction of H. Bornstein, Deere & Co., Moline, Ill., chairman of the committee on cast iron. The various papers presented represent the collection of a large amount of interesting data which should be of considerable value as a reference for engineers.

From the standpoint of nonferrous metals, the 1928 meeting was a geat success. Two sessions were devoted to nonferrous metals, the first featuring aluminum alloys and other alloys for die castings, and the second covering metallography, X-ray studies of nonferrous metals, and the results of tests on bearing bronzes.

Changes made in standardization procedure, which will permit the receipt and publication of committee reports on standardization in the interim between annual meetings, will speed the important service rendered industry by the activities of the society. As pointed out in the report of the executive committee, the safeguards which are thrown around the establishment of an A. S. T. M. standard in no way will be sacrificed by the new procedure.

The meeting was one of the largest in recent years, being attended by approximately 950 members.

Expedites Standardization Work

METHODS for expediting standardization procedure were proposed in the report of the committee on standing committees at the opening session of the American Society for Testing Materials. Recommendations of the committee suggest the establishment of a normal procedure for standing committees to submit reports between annual meetings of the society and the establishment of a method for expediting the publication as tentative, of new standards that have been adopted by a standing committee.

Approve Report

It was pointed out that by permitting committees to present reports to the executive committee at any time, and preprinting the reports and distributing them to members as soon as available, the material will be brought to the attention of the members much more quickly than now is possible. It is believed that since the reports handled in the recommended manner will not reach the members as a part of a large group of reports, more deliberate study will be possible. Recommendations of the committee were approved in the report of the executive committee.

R. E. Hess, assistant secretary of the society, presented the report of the committee on papers and publications. He pointed to the increase in time allotted on the program to the subject of nonferrous metals and alloys. The convention program contained 50 committee reports and 59 technical papers, an increase over the number presented last year.

After tellers had counted the votes, the new officers of the society who were nominated last spring, were declared elected. The officers are as follows: President, T. D. Lynch, consulting metallurgist, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; vice president, F. O. Clements, technical director research laboratories, General Motors Corp., Detroit; executive committee, G. B. Haven, professor of machine design, Massachusetts Institute of Technology, Cambridge, Mass., C. R. Hook, vice president and general manager, American Rolling Mills Co., Middletown, O., H. E. Smith, engineer of materials, New York Central railroad, New York, and G. E. Warren, assistant general manager, Portland Cement association, Chicago.

Outlines Responsibility

In visualizing the work of the American Society for Testing Materials, President G. W. Thompson in the annual presidential address Wednesday evening, outlined the responsibilities of the organization to its membership, which is made up of both producers and consumers. Mr. Thompson pictured the impregnable

Award Medal

IN RECOGNITION of a service rendered the society and industry through the presentation of a paper at the meeting last year on "Long Time or Flow Tests of Carbon Steels at Various Temperatures with Particular Reference to Stresses Below the Proportional Limit," the authors, L. W. Spring and J. J. Kanter, were presented the Charles B. Dudley medal at the Wednesday afternoon session. Mr. Spring is chief chemist and Mr. Kanter is testing engineer of the Crane Co., Chicago.

The fourth annual Edgar Marburg lecture was delivered by Dr. Saul Dushman, assistant director of research laboratory, General Electric Co., Schenectady, N. Y., on the subject "The Nature of Cohesive Forces in Solids."

position of the society and stated that this condition will continue as long as the group performs its functions rationally, justly and with a continuous process of development. It is not the desire to break down any good structure in industrial life, but to build on sound foundations.

C. L. Warwick, in the report of the executive committee, pointed to the growth in membership during the past year. Progress also has been made in the development of student memberships. Since the previous meeting, new committees have been organized on iron-chromium, iron-chromium-nickel and related alloys; on copper and copper alloys, cast and wrought, and on light metals and alloys, cast and wrought. Activities in the field of nonferrous metals and alloys have led to the formation of a co-ordinating committee on nonferrous metals and alloys.

Favorable action was taken by the executive committee on steps to expedite standardization procedure. The new policy will permit receipt and publication of reports of committees between annual meetings.

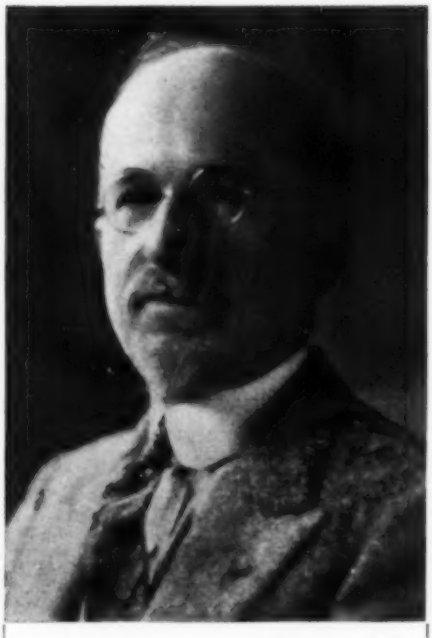
Cast Iron Features Meeting

PHYSICAL properties of cast iron featured the Tuesday evening meeting at which F. O. Clements, General Motors Corp., Detroit, presided. In introducing a symposium on that subject, H. Bornstein, Deere & Co., Moline, Ill., and chairman of committee A-3 on cast iron, pointed to the need for a more definite classification of cast irons and a complete determination of their physical properties. He explained that the purpose of the symposium was to bring together for the engineering profession a general discussion of the physical properties of cast iron.

Presents Symposium

The 11 papers in the symposium were divided into several groups with discussion following the presentation of each group. Under the heading "Classification of Gray Iron Alloys," John W. Bolton, Lunkenheimer Co., Cincinnati, presented five factors influencing the properties of gray iron castings. These include the chemical composition, initial, incidental and final; structure and mechanical make-up of the charge; melting process; thermal and mechanical history; and design and workmanship. Mr. Bolton advocated a primary classification based upon chemical analysis and a secondary classification based on the cooling rate.

The second paper "Effect of Section and Various Compositions on the Physical Properties of Cast Irons," by R. S. MacPherran, Allis-Chalmers Mfg. Co., West Allis, Wis., was read by Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va., in the absence of Mr. MacPherran. The paper described a study on the effect of section on the tensile strength and hardness of three types of cast iron, namely a hard, low-silicon gray iron, a soft, high-silicon gray iron and a high-test cast iron, the latter being alloyed with nickel. Test bars were cast with diameters ranging from 1¼ to 4 inches. Brinell hardness determinations of the entire cross section of the bars were made and the tensile strengths of the material at the center and at the outer edge were determined. It was found that the two gray irons were appreciably harder at the sides than at the center and that the high-test iron had practically the same brinell hardness throughout. It also was found that the tensile strength of the high-test cast irons tends to fall off as the section is increased or as the cooling is retarded, though not to the extent shown in the other two types.



TILLMAN DANIS LYNCH, consulting metallurgical engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was installed as president of the American Society for Testing Materials at its thirty-second annual meeting at Atlantic City, N. J., June 24 to 28. Mr. Lynch was graduated from West Virginia university in 1891 as a civil engineer. He held various engineering positions until 1896, when he was appointed inspector of steel for the United States navy. In 1899 he became affiliated with the Westinghouse company as inspector of raw materials and has remained with that firm since that time. He has served in many offices of several technical organizations being vice president of the American Society for Steel Treating in 1919-20 and president in 1922. He was a director of the American Society for Testing Materials in 1925-26 and was elected vice president in 1927 which office he held until his recent elevation to the presidency. He also has been a member of the society's executive committee for 4 years. Mr. Lynch is chairman of the metallurgical advisory board of Carnegie Institute of Technology, Pittsburgh, and the United States bureau of mines, Pittsburgh division. He is a contributor to the technical press and is the author of many technical papers among which is a paper presented at the International Congress for Testing Materials at Amsterdam, Holland.

Predict Properties

A paper by W. H. Rother and V. M. Mazurie, Buffalo Foundry & Machine Co., Buffalo, on "Correlation of Cast-Iron Test Bars and Castings," was presented by Mr. Mazurie. The authors reported briefly on the work that has been undertaken on that subject and expressed the belief that in the future specifications will cover bars of several sizes so that with intelligent selection of the bar, the properties of a casting may be predicted accurately.

The fourth paper of the group was presented by F. B. Coyle, International Nickel Co., Bayonne, N. J., on the subject "Static Strength of Plain and Alloy Cast Iron." The speaker holds that the only absolute tests for strength of cast iron are those for tension and compression. Through an extension to Maurer's diagram, he showed the relation of composition and structure to tensile strength. This was followed by a series of diagrams showing the extension of the range of composition which will produce a pearlitic structure and maximum strength.

James T. MacKenzie, American Cast Iron Pipe Co., Birmingham, in a paper entitled "Plastic Properties of Cast Iron," presented some original work to show that the ultimate modulus of elasticity is an index of the resistance to plastic deformation or set. He suggested that resilience,

or the area below the stress-strain diagram, and thus a function of both strength and modulus of elasticity, deserves a place on the specifications for cast iron.

Opinions Differ

In the discussion following the presentation of the five papers, J. W. Bolton stated that Mr. MacKenzie's claim that set is due to a crushing action of the graphite flakes and is proportional to the amount of graphite, could not be predicted on the data presented. Written discussions by I. Sugimura, Japan, and J. E. Hurst, England, indicated differences of opinion with the conclusions drawn by Mr. MacKenzie. Norman L. Mochel, Westinghouse Electric & Mfg. Co., Philadelphia, told of some work that had been done with his company in correlating data from castings and test bars. J. S. Varrick, International Nickel Co., Detroit, stated that it is difficult to secure a uniform cooling rate. He suggested the determination of the cooling rate in the section in which the engineer is interested.

The next paper entitled "The Fatigue of Cast Iron," by J. B. Kommers, University of Wisconsin, Madison, Wis., presented results on tests of 14 lots of cast iron. He also presented two formulas for determining maximum unit stress. "Impact Testing of Cast Iron," was the subject of a paper by H. Bornstein. He pointed to the need for a standard impact or shock test and stated that committee A-3 has decided to work toward the establishment of a standard method for making the impact test. Test bars will be made from each of a series of irons having various analyses and these bars will be used to make static tests and to try out various methods of impact testing in use in this country and abroad. The committee hopes to present considerable data and perhaps recommend a standard test for impact at the meeting next year.

A. L. Boeghold, General Motors Corp., Detroit, presented a paper on "Wear Testing of Cast Iron," in which he outlined the various investigations conducted to determine the resisting properties of gray iron. He concluded that a standard wear test is not possible. A paper by E. J. Lowry, Detroit, on "The Machinability of Cast Iron," was presented by J. T. MacKenzie. The author related the detrimental effects of abrasive hardness and described various methods for increasing machinability. H. O. Forrest, Massachusetts Institute of Technology, Cambridge, presented a paper describing methods of making corrosion tests on a series of samples of cast iron pipe. The final paper on the symposium was presented by F. B. Coyle, and dealt with the heat treatment of cast iron.

Accept Tentative Standards

Two committee reports were read at the meeting. The report of the sectional committee on specifications for cast iron pipe was read and approved. H. Bornstein presented the report of committee A-3 on cast iron. As recommended by various subcommittees of A-3, the society accepted as proposed tentative standards specifications for gray-iron castings for valves, flanges and pipe fittings. Tentative revisions were accepted for chilled cast-iron wheels, and the tentative specifications for the arbitration test bars and tension test specimen for cast iron were advanced to standards. Tentative revisions of standard specifications for gray iron castings, for cast iron soil pipe and fittings and for high test gray iron castings were advanced to standard.

Study Methods of Testing Metals

NOMENCLATURE, research and methods of testing were the subjects of reports and papers presented at the session Tuesday afternoon, with G. W. Thompson, president of the association in the chair. In presenting the report of the committee on nomenclature and definitions, Cloyd M. Chapman, consulting engineer, New York, and chairman of the committee, pointed out that 263 definitions have been approved as standard, 117 now are being reviewed, and 213 have not been reviewed. A glossary of all definitions and terms appearing in the standards and tentative standards of the society was issued by the committee during the past year.

Report of the committee on correlation of research was presented by Dr. H. F. Moore, University of Illinois, Urbana, Ill., chairman. Dr. Moore reviewed the work which has been done and that which is planned by the numerous research committees of the society and joint committees with other organizations. Research projects include the determination of the effect of tin and arsenic on high speed tool steel, the study of the yield point of structural steel, correlation of work on the fatigue of metals, the determination of the effect of temperature on the properties of metals, and an investigation of the effect of phosphorus and sulphur in steel. The group studying the fatigue of metals is abstracting all of the literature published during the past year on the subject and will publish the information later. Dr. Moore stated that H. C. Mougey, chief chemist, General Motors Corp., Detroit, has been appointed a member of the committee, replacing G. H. Clamer, Ajax Metal Co., Philadelphia, who retires after five years of service.

Presents Report

Chairman W. H. Fulweiler, United Gas & Improvement Co., Philadelphia, presented a report of the committee on methods of testing. One of the important features of the report was the recommendation of a bend test. The test was developed by A. B. Kinzel, chairman of the section on bend testing. The report was read by Dr. Moore and considerable discussion developed. Dr. L. B. Tuckerman, bureau of standards, Washington, disagreed with the report on the value of the test, in a written discussion read by H. L. Whittemore, also of the bureau of standards. W. B. Miller, a member of the committee, stated that the test first was devised to meet the need for a method for testing welds.

A paper by R. L. Templin, chief engineer of tests, Aluminum Co. of America, New Kensington, Pa., on "Determination of the Significance of the Proportional Limit in the Testing of Metals," brought out the variations which may occur in the value of the proportional limit due to internal strains in the metals, eccentric loading of the specimen, over straining, the use of different types of extensometers and the use of different scales in plotting. The author holds that the yield point is easier to determine on a routine commercial testing basis and that it probably is adequate for the needs of the designer and for product specification purposes. The paper was discussed by Dr. Moore, Dr. Tuckerman, J. A. Capp, General Electric Co., Schenectady, N. Y., P. G. McVetty, Westing-

house Electric & Mfg. Co., East Pittsburgh, and M. O. Withey, University of Wisconsin, Madison, Wis. Dr. Moore pointed out the need for a new definition of yield point in case that factor is used as indicated by the author of the paper, and he suggested a definition that might be used to express the full meaning.

Offers Data on Die Castings

DIE casting problems received considerable attention at the session on nonferrous metals Thursday night. One of the most interesting features of the session was a paper "Aluminum alloys for Pressure Die Castings," by Sam Tour, Lucius Pitkin, Inc., New York. The author discussed the effects of such impurities as iron, zinc, manganese, magnesium, silicon, tin, etc., on aluminum copper, aluminum-copper-silicon, aluminum silicon, aluminum-copper-nickel-silicon and aluminum-silicon-tin alloys. Information was presented to show how these various impurities sometimes impair and sometimes improve such properties as fluidity, shrinkage, solvent action on iron, hot shortness, strength at elevated temperatures, machinability, polishing properties and plating properties. It was pointed out that the iron content and hard spots are of importance.

Undertake Tests

Report of the committee on nonferrous metals and alloys also devoted considerable attention to die casting. Subcommittee on die cast metals and alloys presented a report on a series of tests being undertaken on die cast alloys. The four main phases of the test include tests of 12 aluminum-base alloys in the form of die cast specimens, tests of 9 zinc-base alloys in the form of die cast specimens, corrosion studies of these aluminum and zinc-base alloys and an analysis of the data and the preparation of specifications. The report was submitted by the chairman of the subcommittee, H. A. Anderson, Bell Telephone Laboratories, New York. The basis for the analysis of the test results obtained in the investigation was outlined by W. A. Shewhart of the same company.

Report of committee B-7 on light metals and alloys, cast and wrought, stated that the rapid development of the aluminum casting industry has made obsolete and the tentative specifications for aluminum-base alloy sand-castings and for aluminum-base, sand-casting alloys in ingot form. Revisions in the specifications are under consideration by subcommittee on aluminum base casting alloys.

Data on the endurance properties of aluminum alloys was presented in a paper "Fatigue Resistance of Some Aluminum Alloys," by J. B. Johnson and T. T. Oberg, Air corps, Wright field, Dayton, O. The authors showed that while the endurance or fatigue limit has been assumed on the basis of about 300,000,000 cycles; 500,000,000 cycles are insufficient to determine the limit. The results of the investigation have led to a reduction in the allowable stresses used in the design of aircraft propellers. In the discussion, a number agreed that a great need exists for a short time test of the materials.

FRANK ORVILLE CLEMENTS, technical director of the research laboratories of the General Motors Corp., Detroit, who recently took office as vice president of the American Society for Testing Materials, was born Nov. 9, 1873 at Westerville, O. He received his technical education at Otterbein college, Westerville, O., from which he was graduated with an A. B. degree in 1896. He received an M. A. degree in 1898 and was given an M. S. degree in 1899 by Ohio State university, Columbus, O. After he received his master's degree, he became assistant chemist for the Pennsylvania railroad. In 1903 he was made principal assistant chemist for the Union Pacific railroad. Mr. Clements became chief chemist and engineer of tests for the National Cash Register Co., in 1905 and served as director of research for the Dayton Metal Products Co. from 1917 to 1920. In 1920 he entered the employ of the General Motors Corp., Detroit as technical director of that company's research laboratory which position he now holds. He is a member of a number of technical societies including the American Chemical society, American Association for the Advancement of Science, American Society for Steel Treating, Electrochemical society, British Institute of Metals, Society of Automotive Engineers, and many others. He also is president of the board of trustees of Otterbein college, Westerville, O.

The Friday morning session with H. F. Moore, University of Illinois, Urbana, Ill., as chairman, was devoted to discussion of various problems affecting rolled, wrought and cast nonferrous metals. Studies of the hardness relationship of several commercial copper-zinc and copper tin alloys and three copper-nickel-zinc alloys were presented in a paper by C. H. Davis and E. L. Munson, American Brass Co., Waterbury, Conn. It was noted that hardness-tensile strength relationship not only varies progressively with chemical composition but also is dependent on the previous mechanical and thermal treatment. The paper was discussed by I. H. Cowdrey, Massachusetts Institute of Technology, Cambridge, Mass., R. L. Templin, Aluminum Co. of America, New Kensington, Pa., and W. R. Webster, Bridgeport Brass Co., Bridgeport, Conn.

Standards Remain Tentative

Committee on copper and copper alloys, cast and wrought, reported progress and among other things suggested that tentative specifications for brass ingot metal, graded and ungraded, for sand castings, and tentative specifications for sand castings of the alloy, copper 80 per cent, tin 10 per cent, and lead 10 per cent, remain tentative.

A paper entitled "Bearing Bronzes With and Without Zinc," by H. J. French, bureau of standards, Washington, and E. M. Staples, Bunting Brass & Bronze Co., Toledo, created considerable interest. The authors hold that bronzes with less than 4 per cent tin are unsuited for general bearing service; that bronzes with less than 5 per cent lead appear to be suited for service only where lubrication can be maintained; that bronzes containing more than about 5 per cent lead are best suited to operate for short periods in the absence of lubrication, and that the addition of 4

per cent zinc to bronzes in general had small influence upon the properties of the bronzes studied.

In the discussion which followed, H. E. Smith, New York Central railroad, stated that zinc never is added to a bearing intentionally and that when present, it indicates the use of ordinary yellow scrap brass. W. M. Corse, Washington, stated that the work done by the authors may effect a saving in the number of types of bearings used in the automobile industry. The program of tests will be continued over a period of several years and white metals of babbitt also will be tested. A. L. Davis, Scovill Mfg. Co., Waterbury, Conn., suggested that the metal the bearing is in contact with is of considerable importance and suggested a study of iron and steel.

The report of committee on metallography contained information on the work that is being done by a number of industries and other organizations in using the X-ray equipment to examine metals. The committee recommended the advancement to standard of the tentative recommended practice for radiographic testing of metal castings for physical properties and defects.

Reports on Corrosion and Fatigue

NUMEROUS papers covering corrosion and fatigue of metals were presented at the session on Thursday morning at which Vice President T. D. Lynch presided. Effect of stress, time and the number of cycles on corrosion was discussed at length in a paper entitled "Corrosion of Metals Under Cyclic Stress," by D. J. McAdam Jr., U. S. Naval Engineering Experiment station, Annapolis, Md. Net-damage diagrams were presented to show that for steel and duralumin the stress-cycle relationship for constant net-damage is an expotential relationship. For ordinary steels and probably for duralumin, any stress cycle, however small, accelerates corrosion.

Data presented in a paper "The Influence of Corrosion Accelerators and Inhibitors on Fatigue of Ferrous Metals," by F. N. Speller, I. B. McCorkle and P. F. Mumma, National Tube Co., Pittsburgh, follow up a paper presented by the same authors at the meeting a year ago. The authors showed that as in ordinary corrosion, the stability of surface films is a factor of prime importance in corrosion fatigue. Stress and local corrosion tend to damage the protective films and greatly reduce the life of the metal.

Discuss Testing Machines

Large fatigue testing machines of the rotating cantilever type were discussed in a paper on "Fatigue Tests of Large Specimens," by R. E. Peterson, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These machines were developed originally to test welds and models of large equipment. It was illustrated that fatigue tests of nonuniform material, such as weld metal, show less scatter if large specimens are used than if similar tests are made on specimens of small diameter.

Since some difficulty has been encountered in determining the amount of corrosion on certain types of objects, a method has been developed for making copper replicas of corroded metal objects and the information then is secured from the replicas. The method of making the replicas was described in a paper by E. S. Taylerson, American Sheet & Tin Plate Co., Pittsburgh.

Reports were made by committees on zinc coating of iron and steel, screen wire cloth, corrosion of nonferrous metals and alloys and fatigue of metals. In the latter report it was pointed out that the committee believes the method of applying a repeated high stress of some definite magnitude to specimens of different metals and noting the length of endurance of each metal is unreliable as a measure of the ability of the metals to withstand repeated working stresses. It also was stated that the microscope and the electrical resistance method have possibilities as a means for studying fatigue effects.

At the session on steel and wrought iron, considerable discussion resulted in the report of committee A-1 to advance from tentative standard to standard the specifications for carbon-steel castings for valves, flanges and fittings for high temperature service. John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J., Bradley Stoughton, Lehigh university, Bethlehem, Pa., and A. H. Jameson, Malleable Iron Fittings Co., Branford, Conn., objected to the exclusion of the bessemer converter in the specifications. The recommendations of the committee were adopted by the necessary two-thirds majority.

At the meeting on refractories and related materials on Wednesday morning, the committee on refractories recommended for publication as tentative revisions in the standard method of test for the softening point of fireclay brick.

L. W. SPRING

With J. J. Kanter was awarded the Charles B. Dudley medal of the American Society for Testing Materials. He is chief chemist for the Crane Co., Chicago.

J. J. KANTER

With L. W. Spring was awarded the Charles B. Dudley medal of the American Society for Testing Materials. He is testing engineer for the Crane Co., Chicago.

Eliminates

White Fracture in Malleable

Care in Melting, Regulation of Silicon and Phosphorus Contents, and Temperature of Dumping Pots Assist in Avoiding Difficulty

By D. P. Forbes

NORMAL fracture of blackheart malleable is dark gray with a silky texture and with a narrow white crystalline band on the compression side of the fracture. If the malleable is not annealed correctly it will have a white sparkling fracture due to the presence of nonductile pearlite or cementite mixed with the ferrite of the matrix. If the analysis is *off*, and under certain conditions of anneal, a *picture frame* fracture may result which has a normal black core, and a white sparkling band around the outside, which is often in turn surrounded by a light gray decarburized border.

In these latter cases, combined carbon is always found upon analysis and the metal is hard to machine, non-ductile and often of high tensile strength. The material which will be described is moderately ductile, contains practically no combined carbon, is easily machined, and breaks with a white crystalline fracture throughout.

Heat Specimen Before Fracture

Under the microscope, a prepared section appears to be identical with normal malleable. The sure test for white fracture malleable is to warm a sample slightly, say to 200 degrees Fahr., at which temperature a fresh fracture largely will be black with a sparkling band on the compression side of the fracture slightly wider than usual. The material at this temperature will be ductile and tough.

A characteristic of ferrite or carbon-free iron is its ductility. Therefore, when normal malleable is broken the individual crystals of ferrite are elongated until they break off in the shape of points or spines which have no smooth reflecting surfaces to give a steely appearance. The dark gray appearance is due to the graphite particles exposed at the time of fracture. The ferrite crystals of malleable are held together by an intercrystalline cement which apparently is stronger than the ferrite itself. Not much is known about this cement except that it is attacked more easily by etching solutions than the ferrite crystals and therefore shows up under the microscope as a narrow groove at the crystal boundaries.

When white-fracture malleable is broken, the microscope shows that the line of fracture, instead of going through the ferrite, tends to follow the crystal boundaries, exposing the smooth surfaces of the crystals and giving a steely appearance. This is called an inter-crystalline fracture as distinguished from the transcrystalline fracture of normal malleable. Even if only a portion of the fracture is of the intercrystalline variety, the appearance of the fracture is distinctly steely and may be recognized.

Outlines Methods

FROM time to time malleable cast iron foundrymen encounter difficulty from white fracture metal as distinguished from the normal dark gray fracture. The white fracture differs from the picture frame fracture in that it contains practically no combined carbon, is easily machined, and breaks with a white crystalline fracture throughout. An investigation by a midwestern foundry showed how this condition could be avoided. Methods employed are outlined in this article which is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association. The author is vice president of the Rockford-Northwestern Malleable Iron Co., Rockford, Ill.

Apparently, therefore, white fracture malleable is due either to the weakness or brittleness of the intercrystalline cement at low temperatures or else to a strengthening of ferrite at low temperatures making it stronger than the cement. As it is probable that this cement is amorphous in nature, and as amorphous materials generally become more brittle as the temperature is lowered, it is probable that the cause for the white fracture may be attributed to conditions at the crystal boundaries.

The points covered in this section are largely the result of observations in the laboratory of the foundry with which the author is connected and unfortunately do not afford an exhaustive survey of the whole field. The occurrence of the phenomenon is spasmodic and it is costly to make deliberate attempts to produce white fracture material.

White Fracture Varies

If material likely to cause white fracture is annealed in a single annealing oven, the castings when taken from the oven will not necessarily all be of white fracture when cold; and some castings may be white fracture at one end and normal at the other. This shows the uncertainty and delicacy of the phenomenon.

However, we have noted that we have not encountered white fracture when the silicon content of the white iron was below 1.00 per cent or when the phosphorous content was below 0.17 per cent, and that we almost always have found examples coming from heats with the silicon content 1.10 per cent or over and a phosphorus of 0.20 per cent or over.

We practically have never encountered white fracture iron from a muffle oven where the maximum temperature is 1525 degrees Fahr., and where cooling is extremely slow at about 4 degrees per hour down to 250 degrees when the oven is dumped.

In pot type ovens where the maximum temperature is 1600 degrees Fahr., and where cooling is at the rate of 12 degrees per hour, metal with a tendency toward white fracture may be found if the oven is allowed to cool to 250 degrees before dumping. In fact, if the castings are dumped at about 850 degrees the condition is most noticeable.

In our annealing room our practice for years has been to dump our pot type ovens at about 1000 to 1100 degrees to save time and expedite deliveries. Under these conditions white fracture iron was extremely rare. In fact, the first large quantity of white fracture castings we encountered resulted from the ovens being allowed to cool to room temperature during a shut down from Christmas to New Year. Naturally we do not permit our pot ovens to cool below 1000 degrees in practice.

Quench in Air or Water

The surest way to develop a white fracture in metal having a tendency in that direction, is to heat the casting, after annealing, up to 850 degrees and then quench in air or water. This is what happens in the hot dip galvanizing process and gives rise to galvanizing embrittlement. Castings which after annealing do not show white fracture even at low temperature may become white-fracture castings after galvanizing. There appears to be a critical temperature at 850 degrees from which castings must not be cooled quickly if white-fracture is to be avoided.

We have observed also that melting furnace operation has a bearing on the occurrence of white-fracture castings. When our furnaces are operating normally white-fracture castings are rare. When we encounter a quantity of white-fracture metal we can usually trace it to a single heat in which the furnace operation was abnormal. This usually took the form of excessive oxidation of the charge, or slow melting or slow heating up after the bath was liquid. Whenever we have encountered any quantity of white-fracture iron we usually have found that we also had an abnormal amount of scrap from shrunk and cracked castings.

Have Correct Analysis

The best way to avoid white-fracture malleable is to avoid the conditions under which it is formed.

First, the analysis should be under 1.00 per cent silicon and 0.17 phosphorus. The lower the better.

Second, the melting operation should be normal.

Third, excessively high annealing temperature should be avoided and the oven should be *pulled* at over 1000 degrees.

Fourth, the castings should not be reheated to 850 degrees.

If white-fracture iron is encountered, it is claimed it can be corrected by a patented process, whereby the castings are reheated to 1200 degrees and quickly cooled through the 850-degree range. This is said to make the castings normal again even to the extent of being able to withstand the galvanizing process. It is our understanding, although not supported by our own observations, that prolonged heating, say for 10 or 12 hours at 850 degrees, will cause the phenomenon to reappear.

Microscopic examination at high magnifications of white fracture metal indicates the presence at the grain boundaries of globular inclusions of material dissimilar to ferrite. The fact that these areas are found only at the grain boundaries of the ferrite would indicate that this material did not have a higher melting point than the material which surrounded it or, in other words, was formed after the ferrite. This is the opposite from the case of manganese sulphide which is formed in the solid phase at high temperature and therefore is found at any point in the microstructure, such as in the center of a ferrite grain and only accidentally at the grain boundaries.

To draw a hasty conclusion based upon the facts as we have noted them, we find that phosphorus when present in iron-carbon alloys is soluble in ferrite but insoluble in iron containing combined carbon. The tendency when iron, phosphorus and combined carbon are together, is to form a ternary eutectic with a low melting point.

Phosphorus Remains in Solution

When malleable is at the annealing temperature and the anneal is almost completed it consists of austenite and graphite. As the austenite contains combined carbon, any phosphorus is out of solution and at the austenite grain boundaries. When the metal reaches the critical point in cooling the austenite is presumably almost carbon-free and the ternary eutectic of phosphorus will disappear and the phosphorus be dissolved in the gamma iron as iron phosphide, and will remain in solution in the ferrite after complete cooling.

Under certain conditions of high

(*Concluded on Page* 633)

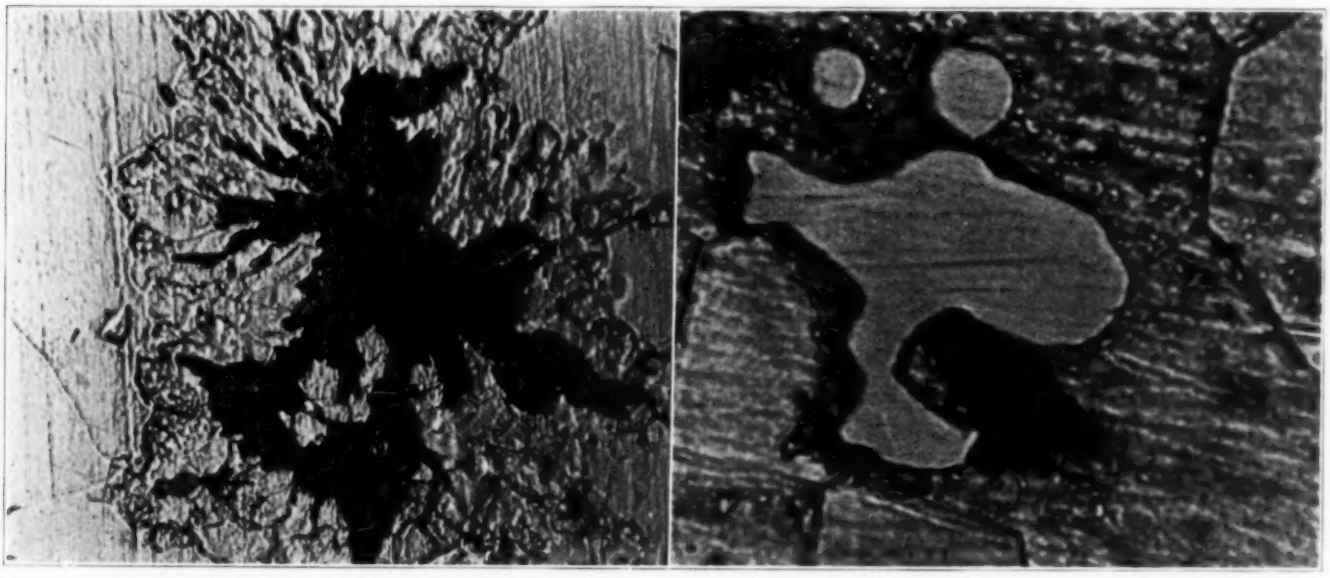


FIG. 1—PECULIAR FORMATION OF TEMPER CARBON USUALLY FOUND IN WHITE FRACTURE MALLEABLE. INDICATIVE OF HIGH ANNEALING TEMPERATURES. ETCHED WITH NITAL. 800 DIAMETERS. FIG. 2—THREE CRYSTALS FOUND AT GRAIN BOUNDARIES OF FERRITE IN WHITE FRACTURE MALLEABLE. LARGER CRYSTAL SHOWN IS MUCH LARGER THAN AVERAGE. 1700 DIAMETERS

Questions & Answers on FOUNDRY PRACTICE

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Steel Casting
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

STEEL

Metal Is Wild

QUESTION

We operate a 500-pound capacity electric furnace bringing down 1200 pounds of steel three times a day. Up to a month ago we never were troubled with wild metal, but about that time the power company installed three 100-kilovolt ampere transformers to replace three old 25-kilovolt ampere transformers, and then grief began. We melt with about 130 volts which under load drops to 100 volts—no change in voltage. We ladle the metal out into hand ladles, one ladle at a time, putting the current on between ladles. The first half of the heat is quiet, but after that begins to get wild. We have tried puddling it several times without results. We use about one pound of aluminum in each heat and a small amount in each ladle. The furnace is lined with silica brick and the analysis of the metal is 0.20 to 0.25 per cent carbon; 0.25 per cent silicon; 0.50 to 0.60 per cent manganese; 0.04 per cent sulphur, and 0.01 to 0.03 per cent phosphorus.

ANSWER

Your inquiry about the probable cause of trouble with the heats produced in your furnace is rather difficult to answer because you present little information on your melting practice. This feature is important because if the metal is not melted properly in the furnace trouble is bound to occur. However, the fact that your steel is all right when pouring begins and goes wild later seems to us a good indication that oxidizing conditions occur which must be guarded against in the latter part of pouring. With the new transformers which allow a greater amount of current to be put in the furnace, changes of temperature and composition are more rapid than with the old transformers.

One thing we advise against before going further, is the use of aluminum in the furnace. Generally, this is considered bad practice by most melters, and in general any use of aluminum is avoided if possible because of its affinity for oxygen and its great tendency to form aluminum oxide which is carried into the mold causing slag spots or hard inclusions. In the case of small castings which have to be poured hot, and then only in the case of green sand molds, aluminum almost is required to get away from small pinholes. In this case the smallest possible quantity of aluminum should be used, and the best way to add it and be sure that it enters the metal is to bore a small hole in the aluminum in which a rod is inserted. The rod and aluminum are then pushed to the bottom of the ladle of metal and stirred around. This will give assurance that the aluminum is where it is wanted, and not floating around on top to form aluminum oxide.

Getting back to the wild metal—note the condition of your slag. It should be a light yellowish green color and not too thick. It should have a bubbling or burning appearance. A test spoon inserted in the bath causes the slag to roll up around the handle. If the slag lies heavy on the metal and difficulty is experienced in forcing the spoon to the steel, the slag should be thinned by adding lime preferably in the shape of small pieces of lime rock.

You may be able to overcome the oxidizing conditions in the bath by giving the entire bath a dusting of coke. The carbon of the coke will take care of the oxygen without adding to the carbon in the bath. Also you might try adding a little ferromanganese. This should be moistened as the steam formed will be enough to give the required kick to force the slag aside and allow the ferromanganese to enter the bath.

As stated previously, so little information is given that we merely can guess at the probable cause of your difficulty. Therefore, we suggest that you go over your melting practice carefully, and check it up. Take test samples as often as necessary to note the condition of your bath, and note the appearance of the slag. Watch the addition of ore and pig and give plenty of time to complete the reactions. Also see that the bath is hot when additions are made so that the reactions will proceed properly. You might also try pouring the whole heat into a 500-pound ladle and fill the hand ladles from it. If the metal begins to grow cold, speed up the pouring by using plenty of hand ladles.

Q & A

Steel Annealing Boxes

QUESTION

We operate a steel foundry in Belgium, and we would like some information on the analysis of a particular grade of steel for the manufacture of annealing pots for sheets or wires.

ANSWER

We have no definite information as to the exact analysis of carbon steel for the manufacture of annealing pots for sheets or wires. We suggest the following analysis: Carbon, 0.08 to 0.18 per cent; silicon, 0.20; phosphorus, 0.05; manganese, 0.4 to 0.7,

and sulphur under 0.05. Some firms in this country are using high chromium alloy steels for annealing pots. These steels will contain around 14 per cent chromium and 60 per cent nickel.

To prevent undue warping of the boxes, they should be heavily ribbed and to prevent cracking the corners should be rounded instead of square.

MALLEABLE

Iron Is Mottled

QUESTION

We are melting in a 5-ton furnace and our malleable iron comes too soft, frequently showing carbon spots. Our mixture consists of 4500 pounds of pig iron, 2000 pounds of annealed scrap, and 3500 pounds of return scarp. The pig iron charge is made up of 1000 pounds containing 2.0 per cent silicon; 1500 pounds with 1.86 per cent silicon and 2000 pounds containing 0.85 per cent silicon. We tried adding 800 pounds of steel but the mottled iron persisted.

ANSWER

Soft and mottled structure may be caused by two things; too high silicon and too high manganese content. Manganese should not be over 0.30 per cent and the silicon not over 1.0 per cent. If your castings are moderately heavy, even less silicon should be present. Although we cannot determine the amount of silicon in your iron, we judge that there is more than 1 per cent silicon present in the iron as it comes from the spout. Not knowing the composition of your scrap iron, we only can recommend that you use more of the pig containing 0.85 per cent silicon. Do not increase your annealed scrap and do not use more than 5 per cent steel scrap in the mixture. An analysis of your metal will show whether the silicon and manganese are too high.

Q & A

Casting Is Not Round

QUESTION

We are sending you a malleable iron gear casting that comes out of round after annealing. They are true in the white iron, and the only reason we can think of is that during the annealing the gears expand. Due to the heavy and light sections the contraction after expansion is not equal. The castings are packed flat for annealing.

ANSWER

It often happens that round castings go out-of-round unless gated properly. No set rule may be made as to the number of gates and their placement. It is a matter of experience and judgment; what may be suitable for one casting causes trouble in another. Therefore your difficulty probably is due to the method of gating used in making the casting.

However, you did not state whether any of the diameters is the correct one; that is to say whether expansion or contraction was the cause of the casting being out-of-round. The ideal way to gate a round casting would be to place a series of gates about an inch apart around the circumference, but generally this is impractical and wastes considerable iron in the sprues.

Try three gates instead of two. These gates should be spaced equally around the circumference. The matter of placement will have to be experimented with and we suggest that you try placing one gate opposite the heavy section, one at the edge of the section bearing the part number and the other at the edge of the heavy section with the hole in it.

Another scheme that is used to make castings come round is to make the pattern slightly oval, with the bulge at the section that pulls in. When the iron contracts, it pulls in the bulge and corrects the excess contraction. Such a method would not be applicable in your case due to the teeth having an angular pitch, and the pattern could not be drawn properly.

GENERAL

Cement Is Employed

QUESTION

For some time past we have been using portland cement as a facing on our green sand molds for iron and steel castings from 1 to 1000 pounds. Formerly the heavier castings were skin dried, but since we began using the cement we have not dried any of the molds and apparently the castings are cleaner than those made under former conditions. The cement forms a crust on the face of the mold and absorbs all the moisture. Also the cement seems to possess more refractory qualities than the sand. We are wondering if the cement will affect adversely the composition of the metal. Will the continued use of cement ultimately affect the sand from which the molds are made?

ANSWER

Use of portland cement as a facing material is not a new departure in foundry practice. It has been tried experimentally both in the gray iron and steel foundry, but the practice never has been adopted to any great extent. The greatest objection to its adoption is its tendency to cake upon exposure to moisture. Theoretically it can be kept dry, but in actual foundry practice it constantly is exposed to moisture. Unless the amount is calculated carefully in proportion to the moisture content of the sand, the surplus cement on the face of the mold will roll ahead of the molten metal and some dirty areas will appear on the face of the casting.

The great aim of the foundryman is to maintain maximum permeability in his sand. Although we cannot call to mind an instance where continued use of cement facing ruined the permeability, still we are inclined to the opinion that its continued use is detrimental. In the only instance with which we are familiar, its use was discontinued for other reasons before the sand was effected to any great extent.

We do not see how cement will affect the chemical composition of the metal. It is prepared at a temperature practically equaling that of molten steel, therefore no further reaction will take place when it is exposed to the molten steel in the mold. For your general information the essential elements of portland cement are lime, silica and alumina. Some cement mills use cement rock and limestone; some use limestone and clay or shale; others use marl and clay; while still others use blast furnace slag and limestone. This material in proper proportions is ground to a powder and then burned in kilns at a temperature high enough to melt steel. The resulting clinker is cooled and then ground to a powder so fine than 75 per cent will shake through a sieve with 40,000 holes to the square inch, a sieve that is finer than silk, a sieve that will hold water. The material is cheap, it imparts a clean skin to the castings, but it has not found favor in the foundry industry. In limited amount it may not affect the permeability of the sand for a long time, but where it is used extensively we are afraid the sand is bound to tighten up and cause cuts and scabs on the castings.

Q & A

Bed Height Is Same

QUESTION

We shall appreciate your decision on the following question: *A* claims that the height of the cupola bed varies with the diameter of the cupola. *B* maintains that a uniform height of bed is maintained in all cupolas irrespective of the diameter.

ANSWER

The diameter of the cupola has nothing at all to do with the proper height of the coke bed. In this connection also it may be of interest to point out that the height of the bed is not reckoned from the sand bottom. The height is calculated from the top edge of the tuyeres and in the majority of instances is set at 30 inches.

The coke below the tuyeres merely serves for a foundation to support the column of material in the cupola. The coke above the tuyeres takes all the blast and is in an active state of combustion. Naturally the blast travels upward and toward the center and as a result the most intense heat is developed at a certain point about 20 inches above the tuyere line. This zone of intense heat extends approximately 10 inches above this point and 10 inches below it, thus placing the upper limit about 30 inches above the tuyeres and the lower limit about 10 inches above the same mark. This is the zone where all the melting and superheating takes place. The coke is consumed as it passes through this area and constantly is replaced by the charge of coke immediately above. The amount of coke is calculated to melt a given charge of iron and in that manner the height of the bed is maintained at approximately the same level throughout the duration of the heat.

GRAY IRON

Valve Body Mixture

QUESTION

We have been attempting to formulate a good analysis for making valve bodies that will withstand 175 pounds per square inch pressure. We made up a mixture containing 25 per cent steel with the silicon around 1.50 per cent; manganese, 0.80 per cent, and nickel, 1 per cent. These castings poured satisfactorily, but practically were unmachinable as they were too hard. Have you any information on a mixture to be used for this purpose?

ANSWER

You do not state what wall thickness you have on your valve bodies, so it is difficult to prescribe a remedy. However, it appears that your silicon is too low for the wall thickness. For small valves, the silicon should run between 1.75 and 2.25 per cent, and for large valves the silicon ranges between 1.25 and 1.75 per cent.

It is possible that the molten metal was not mixed well and you obtained most of the steel in the metal used for the valves. One of the essential requirements in using large amounts of steel scrap is the use of a mixing ladle at the spout of the cupola which is capable of holding at least a charge, and preferably a charge and a half. This will insure a uniform mixture of iron.

If you want to hold your silicon around 1.50 per cent as you mention, you may have to cut down the amount of steel scrap to 10 or 15 per cent. With the use of 1 per cent nickel you should obtain machinable castings unless, as we have stated, the metal is not mixed well. If you obtained practically all the steel of the charge for pouring the valves, you would have a low silicon, low carbon metal. Therefore we suggest that you first check up on your melting and mixing of the liquid iron.

Q & A

Will Resist Heat

QUESTION

We are interested in the manufacture of heat resisting castings and would like to have any information that you can give us on the use of chromium for producing that type of castings. We are not interested in the wear resisting properties, but do want to make castings that will withstand temperatures from 1100 to 1200 degrees Fahr. continuously.

ANSWER

Chromium additions up to 13 per cent have been found advantageous for preventing oxidation at temperatures around 1832 degrees Fahr. However, unless the carbon is kept low these irons may be too brittle for many purposes. If the carbon content can be held around 2.5 per cent, a dense, fibrous, tough iron results. This may be done by using an electric furnace and heavy steel additions, but practically is out of question in the cupola. However, since the temperatures that your iron has to withstand are lower than 1800 degrees Fahr., perhaps a chromium content around 7 per cent may prove satisfactory for your purpose. Low carbon content is advisable also and large steel additions may assist in keeping that element down.

Large amounts of chromium as specified should be added in the cupola in the form of ¼-inch size ferrochromium or a shot alloy composed of nickel and chromium. This material is covered with a paste of highly refractory clay or cement and allowed to dry. The balls of alloy and clay or cement are added to the charge in the usual way. Another alloy iron recommended for such purposes as grate bars, etc., contains 1.10 per cent silicon; 0.95 per cent nickel, and 0.50 per cent chromium. Low carbon is attained by using nearly all steel scrap for the charge. This iron shoud be annealed at 1500 degrees Fahr. for 4 hours to relieve casting strains. None of the irons mentioned will be machinable.

Q & A

Needs Strong Iron

QUESTION

Can you give us any information on the best composition for castings to be used for vulcanizing automobile tires?

ANSWER

Tire molds require a strong, hard iron that may be machined readily. One foundry that specializes in this type of casting uses low-sulphur, low-phosphorus, high-manganese pig iron, cast iron scrap and steel scrap in the following proportions: Pig iron, 30 per cent; cast iron scrap, 55 per cent, and steel scrap, 15 per cent. This mixture yielded iron with the following analysis: Silicon, 1.75 per cent; sulphur, 0.07 per cent; phosphorus, 0.30 per cent, and manganese, 0.80 to 1.0 per cent.

Q & A

Crack When Cooling

QUESTION

We have been unsuccessful in casting chilled traction wheels as they crack when cooling. Can you give us a mixture that will overcome this difficulty? How can we obtain a deep chill?

ANSWER

It is rather difficult to analyze your trouble due to lack of information. Manufacture of chilled wheels is a specialized operation and unless some experience has been had in the field, trouble will be met that takes time to overcome.

According to the specifications of the American Society for Testing Materials, the following analysis must be maintained: Total carbon, 3.25 per cent; combined carbon, maximum, 0.85 per cent; silicon, 0.45 to 0.75 per cent; manganese, 0.50 to 0.75 per cent; phosphorus, maximum, 0.40 per cent, and sulphur, 0.15 per cent.

You do not state whether you have annealing pits for the slow cooling and heat treatment of the wheels. All chilled wheel makers employ these pits which are slightly larger than the wheels. They are sunk in the floor and hold from 12 to 30 wheels. These pits are heated by wood or oil fires before the wheels are placed in them.

The wheels are snaken out red hot and placed immediately in the pits and allowed to stay there from four to five days. When removed, the top wheel will have a temperature around 800 degrees Fahr.

A comprehensive series of articles on the manufacture of chilled car wheels was published in the April 1, April 15, May 1, May 15, June 1, June 15, 1920, issues of THE FOUNDRY.

Depth of chill is controlled by the silicon and the temperature of pouring. A general rule for chill is that the hotter the iron is poured, the deeper the chill will be. Of course, the lower the silicon is maintained, the greater the tendency to white fracture. However, since all but the tread of the wheel should be gray, the silicon cannot be decreased too far.

Problems in Nonferrous Founding

By Charles Vickers

Gating May Be Trouble

We have had some difficulty in casting aluminum cookers so that they will hold pressures after being machined inside and outside. The molds are made of sand and the castings resemble a dome with a hub 2 inches in diameter and 2 inches high on the outer surface of the closed end. The gate is located on top of this hub, and No. 12 aluminum alloy is used as the metal. When we use an iron pot for melting, we find a pouring temperature of 1400 degrees Fahr. gives the best results, but we find small specks of oxide in some castings. In the open-flame furnace using chloride of zinc in both the furnace and the pouring-off crucible we eliminate the oxide, but large holes appear when the castings are machined. From the open flame furnace we pour at 1400 degrees, the charge being from 400 to 800 pounds. We think the holes may be caused by the time it takes to empty the furnace. Is there any flux that will eliminate the large holes? These occur when the temperature of the metal drops to 1300 degrees Fahr. or a little lower. Do you think the No. 12 alloy best to use, or should a silicon alloy be substituted?

The No. 12 aluminum alloy is not noted for its pressure holding qualities, and we suggest a trial of the following alloy: Pure commercial aluminum ingot, 86 per cent; copper, 12 per cent, and tin, 2 per cent. Pressure-resisting alloys also can be purchased ready to use, and it might be advisable to investigate the possibilities of such metals. By the use of a more suitable alloy than No. 12 for the castings mentioned one difficulty will be eliminated, so that when a perfect casting is obtained the chances will favor its holding the pressure to which it will be subjected.

Although a temperature of 1300 degrees Fahr. for pouring aluminum alloys is not usually considered *cool*, nevertheless, with castings of certain shapes, that temperature may be exceeded as appears to be the case with these cookers. The question arises as to whether the method of gating is not largly responsible for this defect of holes. After a little reflection anyone can visualize the metal after it has spread across the bottom of the cooker, raining or dribbling down the sides of the mold, depending on the speed of pouring, and is it not likely that air will be trapped as the metal streams meet at the mold bottom? We should imagine that the trapping of air will be governed by the fluidity of the metal and the speed of pouring, and this means it is a condition difficult to control. The metal cools as the furnace empties in the case of the open flame, and gets hotter with the pot furnace if the flame is kept on.

We suggest after the alloy has been changed as suggested, that if the trouble from holes still continues, that the gating be changed to the bottom flange. Running a channel all around the flange and cut in small gates every 2½ inches from the ring runner to the flange. Put a riser on the hub and carry the sprue up 6 inches above the top of the hub. Make a few experiments to discover the lowest temperature that will fill the mold completely. Then regulate this by pyrometer in all future heats. Fluxes can be obtained that are useful in melting aluminum; most foundry supply houses carry them. We believe it would be advantageous to use a flux.

Q & A

Mandrel Is Cool

For many years we have been babbitting railroad bearings, and have had only the regular foundry troubles, but recently the railroad has asked us to broach the babbitt. We find that after doing this we have about 25 per cent of the castings with holes; from one small hole, up to 24 holes. We pour the babbitt from around 700 to 750 degrees Fahr. It is poured against an iron form all tinned and warm. The analysis of the babbitt is 86 per cent lead; 4 per cent tin, and 10 per cent antimony. Can you set us right?

Possibly when pouring first is begun the mandrel is cooler than it should be, and it produces defective linings until it gets heated up. By marking the first bearings that are lined and observing them after they are broached this point can be decided and corrections can be made. A small pinch of powdered rosin dropped in between mandrel and bearing just before pouring sometimes is helpful in eliminating these holes. This requirement of broaching by the railroads causes much trouble to the foundryman as it exposes small holes whenever they are present and adds to the loss in making the bearings. The holes really do no harm as they fill up with lubricants and are probably more of an asset than a liability.

Q & A

Iron Is Not Removed

We are manufacturing manganese bronze motor boat propellers and find that a small amount of iron gets entangled in the turnings. This is just enough to prove troublesome because on remelting and casting the turnings, the castings contain little specks of iron scattered on the surface. We have tried to remove the iron with magnets but have had no success. Is there any flux that we could add to the turnings that will fix the iron so that it can be skimmed off in the slag?

You do not state whether the magnets you used are of the ordinary garden variety or of the electromagnetic type which are much more powerful. If you are using the first named type, you probably can remove the larger pieces, but much of the finer iron will escape. The electromagnetic type such as used on magnetic separators are used successfully in many foundries to separate tramp iron from nonferrous turnings. If you are using one of the latter type, we advise that you have it examined carefully by an experienced man to see that it functions properly.

It is possible that the iron you refer to comes from another source, and that it is in the form of inclusions from a previous melting. If so, you will have difficulty in removing it as there is no flux that will unite with the iron to form a slag.

The FOUNDRY Family Photograph Album

Upper Left

A. W. WALKER

Walker & Pratt Mfg. Co., Boston

Lower Left

R. H. RIPLEY

American Steel Foundries, Chicago

Upper Right

W. A. MARSCHKE

Marschke Mfg. Co., Indianapolis

Lower Right

O. J. BLANK

Peck, Stow & Wilcox Co., Cleveland

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

ALUMINUM BRONZE DATA

(*Continued from Data Sheet No. 772*)

addition of the aluminum, owing partly to the reduction of any oxides remaining, partly to the formation of the compound Cu_2Al. When this exothermic action has subsided, skim again and either allow to cool to the required temperature for pouring or teem into ingot molds. Do not retain molten for longer than is necessary.

The usual deoxidizer for the common brasses, phosphor-copper, is not recommended for aluminum bronze.

These precautions, carefully executed, will counteract any trouble due to drossy patches originating in the melt, the most prolific source. Should oxides cause trouble in spite of such precautions, they may be removed largely by adding small percentages of manganese sulphate, forcing the crystals down into the melt, and stirring with as little disturbance of the surface as possible.

The first step with pinholes lies in preventing as far as possible the absorption of gas into the melt, by using low melting temperatures, by the avoidance of splashing or turbulence, and by pouring at low temperatures, as soon as possible after melting.

Melting Temperature

Aluminum bronzes melt between 1035 and 1050 degrees Cent. (1895 to 1922 degrees Fahr.) and the figure for the 10 per cent alloy is approximately 1040 degrees Cent. (1904 degrees Fahr.). In the case of many of the nonferrous alloys, as for example phosphor bronze and the light alloys of aluminum, melting temperature has some considerable bearing on the subsequent properties of the casting, these being definitely impaired by high temperature melting. Within reasonable practical limits no such restrictions are imposed in the case of aluminum bronze. The range of temperature which may be used without adversely affecting the properties of the material is an unusually wide one, and the main precaution is one with which few modern founders will be unfamiliar.

As stated previously, both aluminum and copper will absorb gases when maintained at high temperature for long, and the usual crucible as used for this material with the pit-type furnace offers little resistance to the passage of furnace gases into the metal. It is not realized generally how porous ordinary crucibles may be to the passage of gases when at high temperature, and it is sound routine practice to melt only to temperatures which ensure fluidity, and to pour within a reasonable time after melting.

Pouring Temperature

Correct temperature for pouring, as in the case of the light alloys of aluminum, is the lowest at which a complete casting to any one design

(*Continued on Data Sheet No. 774*)

ALUMINUM BRONZE DATA

(*Continued from Data Sheet No. 773*)

may be obtained with regularity. A fair average for ordinary work is about 1200 degrees Cent. (2192 degrees Fahr.) but naturally conditions vary with the section and intricacy of the casting, and many are poured without difficulty at about 1060 degrees Cent. (1940 degrees Fahr.). The lower temperature always is to be preferred where feasible, because the lower the temperature the lower the total shrinkage. Further, the risk of self-annealing with accompanying poor physical properties, is always less where the mold will rapidly solidify the casting. It will be clear that if the mold is called upon to absorb an unnecessary amount of heat before solidification commences, it will lose much of its capacity for rapid chilling.

The previous material refers to gases which go into solution in the melt, and which are likely to be liberated during freezing. There is another and less suspected source of pinholing in all cast metals, in air or furnace gases which do not go readily into solution, but which readily are entangled in the melt by careless stirring, splashing of metal into crucibles from a height, or by gates which spray the metal into the mold at high velocity. If air is stirred into aluminum bronze, oxygen is at once converted to the oxide one wants to avoid, leaving nitrogen. The latter is not dissolved easily but is entangled quite easily, and entangled nitrogen can cause as many pinholes as any amount of dissolved hydrogen.

If a bottle of carbonated water is poured from a height into a glass the result is a mass of minute bubbles due to liberated dissolved gases. If soapy water is poured from the same height into a glass there is no release of dissolved gases, but there may be quite as many small bubbles due to air being drawn into the main body of water by the descending stream, and being entangled therein. The causes are essentially different in the two cases quoted but the effect is the same and, so far as the founder is concerned, the effect of a pinholed structure will be the same whether due to dissolved gas or to entangled air.

For this reason, stirring must be restrained and intelligent, from the bottom upwards and with as little disturbance of the surface as possible. Wherever feasible the actual melting pot may be conveyed to the mold with great advantage. The metal must enter the mold with a minimum of churning or abrupt change of direction, and this will be covered under the section on gating.

Sand Condition

If a sheet of molten aluminum bronze is poured out on to a prepared bed of green sand, in nine cases out of ten the metal will start bubbling and quivering owing to interaction between the hot metal and gases re-

(*Continued on Data Sheet No. 777*)

Bill Explains Cause of Swelled Castings

By Pat Dwyer

FOR quite a while I was puzzled by a peculiar odor in a section of the city through which I pass daily about the hour of noon. 'Tis true that my nose is set a little sharper than usual on these occasions, as becomes a man who has toiled diligently through the long weary hours that intervene between breakfast and lunch.

Sometimes I wonder if man has not made a mistake in adopting certain arbitrary hours for stuffing his body with food. We are taught that the human body is a furnace in which food is consumed as fuel is burned under a boiler to produce energy. Is it not just as illogical to pack the stomach with food three times a day as it would be for a fireman to cram coal up to the crown sheet in the firebox? With dieting propaganda running rampant through all the length and breadth of this fair land, I am rather surprised to find that no foxy lad has hit on the brilliant idea of advocating a rational method of firing the human boiler. The total amount of food for each person per day to remain as at present, but it should be taken in a small steady stream rather than in periodical cloudbursts. If I had the time, if you had the patience, if the subject was worthy or if I thought I could sell the idea for a reasonable sum, I might be tempted to enlarge upon this theme.

However, since the time is limited, the patience is problematical, the subject is too new to attract attention and the chance of selling the idea is about equal to my chance of selling the moon to a green grocer, I shall waive the point for the moment and return to the odorous atmosphere of West Sixth street and Superior avenue.

The tainted gale, as the late W. Scott happily phrased it, is noticeable only when the aforesaid gale comes from the south. The taint is not exactly reminiscent of the perfumed breezes that blow o'er Ceylon's lovely isle, where—if the old memory is in working order—every prospect pleases and only man is vile and so forth, but it—the taint if you please—is not offensive. In fact it is elusively pleasant and familiar and I felt deeply chagrined when Bill solved the mystery for me one day.

"That smell?" he inquired in surprise. "For a fella that's been around a foundry as long as you have, you certainly ask some of the dumbest questions. That smell is from what's-their-name paint factory where they prepare linseed oil."

Through a natural association of ideas my mind soared away through time and space to where the smiling blue flax fields of Argentina ripple gently at night under the soft velvet stars of the Southern Cross. At harvest time the ox teams strain across the plains of Santa Fe and big boats come drifting down the Parana to where that turbid flood mingles with the waters of the Uruguay to form the mighty Rio de la Plata, better known as the River Plate to English speaking sea men.

At the docks in Buenos Aires the slithery cargo is poured into the hold of a big bluff bowed iron tramp that slips away in the night from the shining lights of the greatest of South American cities. East through the wide estuary of the Plate and then north and ever northward for seemingly endless days and nights, through storm and calm, under the burning sun of the Equator, through tropic seas and green Atlantic surges, the churning screw drives the vessel straight and true as a homing pigeon to its goal.

One by one the parallels of latitude are dropped behind like the rungs of a mighty ladder. Stormy Hatteras is passed far to port and the soft Virginia capes. Entering the port of New York the long monotonous days are over. With a bunch of waste in one grimy paw, with eye and ear cocked for signals from the bridge, the chief slacks the old coffee mill down from *Full* to *Half* to *Slow* to *Stop*.

Cargo booms swing over the gaping hatches, deck winches rattle, bags are whipped out and the contents spilled into an elevator. Box cars specially lined are spotted under the chutes and loaded and then made up into long trains with hundreds of cars of other commodities destined for the comfort, convenience, pleasure and necessities of the inhabitants of the Middle West.

Belching smoke and defiance, screaming arrogantly for right of way, the mighty dragon with many a twist and turn climbs over the mountain and then slides down the far side with brakes hard set and wheels screeching angry protest as they round the curves. Smoky Pittsburgh and the broad Ohio river are left behind. The long train rumbles and roars through smiling fertile valleys and finally rolls into Cleveland. A long, long way from where it was planted, where it sprouted, where it ar-

ALL BULL THROWING IS NOT DONE IN SPAIN

rived at oily maturity and was garnered into bags, the flax seed from the fertile pampas of Argentina is fed to the crushers and converted into linseed oil.

In a sketchy manner I outlined some of the foregoing program to Bill.

"Incidents like that," I said, "show the average man how insignificant he is and what a small part he plays in carrying on the world's work. Most of us spend our lives in some little routine job and our entire existence is spent inside a radius of one or two miles. It is too late now to begin, but sometimes I wish I had joined the argonauts of commerce who spend their lives trading to the round world's rim."

"Well," said Bill, "I'll tell you. The average man is a peculiar kind of a beast. He never is satisfied. Irrespective of the particular sphere in life (See any collection of pudgy speeches by those who sit in high places) to which providence has been pleased to call him, he still thinks he might have shone to better advantage elsewhere. The molder bitterly curses the day he entered a foundry. He is quite certain that if he had started out as a peddler of mouse traps, hair pins and fake jewelry, he would have achieved financial independence before his fortieth year as the owner of the largest department store in the city.

"The owner of a foundry is quite certain that he would be far better satisfied practicing law or medicine, or lording it over the broad acres of a farm. The operator chained to a machine wistfully visualizes a free and open life on the ocean wave and the highest ambition of those who go down to the sea in ships is to settle down permanently as far from the sea as possible and cultivate a garden and maybe raise a few chickens.

"Usually a man has no opportunity to try one of these radical shifts. A hundred reasons keep him chained to his own particular oar in the galley. Instead of wearing thinner, the bonds increase in strength with the passing years and he cannot break away until the old gentleman with the long beard, the hour glass and the scythe unlocks the manacles and takes him for a ride. At last he is free, but unfortunately he never comes back to tell us the story of his adventures, if any, or how he liked traveling on a one-way ticket.

"Occasionally a stout hearted hero breaks away of his own volition. He climbs out of the rut of years and joyously goes adventuring. He cheerfully cuts all the bonds that have held him in a fixed location. Like a gaudy and irresponsible butterfly he emerges from his cocoon and flies high, wide and handsome for a long or short period, depending on circumstances as they develop along the way.

"In a recent issue of a popular magazine I read the story of one of these lads, set down by his own hand and illustrated handsomely with a grand collection of photographs taken on the journey. He was on the road for two and a half years, passed through eleven American republics and covered 9600 miles of desert and plain, mountain and jungle. He traveled paved roads, Indian trails, water courses, and for long distances he fared over virgin territory with nothing to guide him but an innate sense of direction, the instinct of his horse and the ability, as the saying goes, of following his nose.

THEY BADE EACH OTHER AN AFFECTIONATE FAREWELL

"As readily may be imagined, the going in places was tough. In fact he admits at one stage of the narrative that all the money in the world —and that's quite a tidy sum—would not tempt him to pass again the desert waste along the coast of Peru before he arrived at the border of Ecuador. The only difference between this God forsaken territory and Dante's *Inferno* is that the inferno is imaginary, while this place is the pure quill."

"I wish you would come back from this pure quill place for a minute," I interrupted, "and tell me a few things so that I may follow you intelligently. How did this lad land in Peru? Where did he start, where was he going and where did he finish? Was he alone or was he accompanied by the usual explorer's *safari* of 100 men, 67 pack animals, a stove and dining room table, table silver, napkins, finger bowls and a bath tub?"

"You are hopelessly old fashioned," Bill replied, pityingly. "In this modern age, no person would think of telling or writing a story by commencing at the beginning and then follow through by a series of logical sequences to a reasonable conclusion. The movies are responsible for this new technique.

"They open with a thrilling scene in which the young superintendent J. Fenton Bingo, in natty overalls and high boots is showing the president of the construction company how to throw a steel bridge across the Yang-tsi-Kiang. The caption 'I know I am right, Sir!' conveys to the spectators that the overbearing old plutocrat in the swivel chair is all wet, as usual. The president's daughter, Betty Jane, sitting in the anteroom, is an interested listener to this conversation. Her father has maintained a luxurious establishment and has kept her in luxury all her life, but on hearing the ringing declaration of the young hero, she immediately realizes that the old man is a fossil and should have a guardian appointed. The logical man for the position is J. Fenton Bingo. A series of flash backs then shows (a) J. Fenton aged 14 leaning heavily with both fists on a gross youth who had stepped on Betty's toe at a children's party (b) J. Fenton in his senior year, practically alone and unaided scoring the winning touchdown for dear old Alma Mater (c) J. Fenton in faultless evening dress at Betty's coming out party a year before, and telling her that he has accepted a position on her father's engineering staff. All he needs is one little smile of encouragement and he *knows* he will MAKE GOOD!

"By this time you and I and all the others watching the picture, share Betty's confident belief that J. Fenton is going to make a monkey out of the old man and we settle back comfortably to watch the unfolding of the drama. If the movie makers started at the proper beginning, the picture would not have the necessary *kick*—."

"Tell the rest of it," I said, "to Mary Anne McCarthy, the champion clam digger. She may be interested. I'm not. I want to know about this long distance tourist and I am old fashioned enough, if you want to put it that way, to prefer hearing the

beginning of the story at the beginning if you know what that means."

"Righto, me hearty," said Bill. "I was just going to give you the first flashback anyway. Behold our hero, a teacher by profession in England and Argentina, good and sick of the whole business, for which I do not blame him in the least. You know it is not the heat, its the humidity of a student body that is hopelessly all wet.

"Casting about in his mind for a plan that would take him quickest and farthest and for the longest period of time from his tormenters, at the least possible cost, he hit on the idea of riding horseback from Buenos Aires to Washington. Incidentally he wanted to test the truth of a tradition regarding the decendants of horses originally brought to the country by the Spaniards. According to all accounts these animals can live on next to nothing and travel forever without showing signs of fatigue. His experiment seems to bear out the claim. He selected two wiry little skates 17 years old and they were in better condition when he shipped them home from New York than when they left Buenos Aires 2½ years before. Iron horses, my boy, and they did not need any pair of steel rails to run on either!

"He traveled north by west through Argentina and Bolivia and over the towering Andean ranges into Peru. Thence northward into the Cordilleras of Columbia. Warned that he could not possibly travel through the jungles leading into Panama, he loaded himself and horses on a stern wheel steamer and traveled down the Magdalena river to the ancient city of Cartegena on the Caribbean, one time magnet of Drake's and Flint's and Morgan's men and other gentlemen of fortune who sailed under the Jolly Roger.

"From Cartegena he sailed to Colon. He crossed the isthmus and then moved through Panama into Costa Rica. Rumor of revolution in Nicaraugua led him to take ship in Puntarenas for La Union in Salvador. From Salvador, he traveled through Guatemala into Mexico and then through Texas, Oklahoma, Missouri, Illinois, Indiana, Ohio, Pennsylvania and Maryland into Washington.

"Curiously enough, he found traveling conditions worse in the United States than in the so-called waste places of the earth. Concrete roads are excellent for motor traffic, but they are hard and tiring on horses. Heavy motor traffic makes horseback riding anything but pleasant. The problem of stabling the horse in American towns is not as simple as it was in former days. Stables have given way to garages nearly every place."

"What happened the lad," I asked, "after he arrived in Washington?"

"Search me," Bill replied. "The story ends right there. Perhaps he started a correspondence school for the benefit of long distance hikers. Talking about correspondence courses," he continued, "Reminds me of a query I had from a man some time ago. He forwarded a blueprint of a large and rather intricate double bracket or pedestal which he stated came out of the mold badly swollen at the deep end and along the sides. The casting, 4 feet 6 inches one way, and 5 feet the other, weighed 2000 pounds. To insure a smooth, flat face on the deep flange which forms the base of the casting he placed a flat core against this face of the pattern. The drag was rammed on a rollover board and then lowered into a hole in the floor with the joint line flush with the floor. He wanted to know why the casting swelled and how to prevent it.

GOOD ROADS ARE THE WORST ROADS TO HIM

"I told him any casting 4 feet deep poured in a green sand mold will strain to a certain extent, but the strain may be minimized by observing certain precautions. For example the sand must be worked as dry as possible and rammed quite hard. If the sand is fine and tight it cannot be used for making molds of this character. A coarse, open grain sand must be employed so that when it is rammed hard the steam and gas may escape through it. The casting should be gated from the joint at a point farthest away from the deep flange. In this manner the flange will fill slowly with iron at a cooler temperature than the remainder. This iron will commence to freeze at the bottom of the flange first and thus will not exert the same fluid pressure against the sides of the mold as it rises. The iron should be poured through generous gates at a speed to prevent cold shuts, but slowly enough to avoid placing an undue strain on the mold. Pouring should cease when the iron appears in the bottom of the risers. One or two *touches* with a small stream from the ladle later will bring the iron up in the risers and prevent *draws*, shrinks and cracks on the under side where the horizontal and vertical members meet.

"Ramming the drag on a rollover board presents certain advantages, but practically all the advantage is lost unless the flask is exceedingly strong and rugged. The sand even in a stiff flask will settle to some extent in the rollover process. In a weak flask the sand will give to such an extent that the casting will be distorted all over. If men are accustomed to bedding patterns in the floor, they will make a better job of this casting by bedding the pattern directly in the floor and working from the bottom up. I assume that the pattern is of plain box construction and that the space between the two bracket members is made up with dry sand cores. If the flask is large enough so that a man may work around the pattern, it may be sunk in the floor and rammed in place to form an iron lined pit. In this manner the flask will prevent the sand from yielding, because the very act of ramming the sand inside it expands it to whatever may be its limit. Needless to say reference throughout is to cast iron or steel flasks. I do not think a wood flask possibly could be braced.

"The plan of forming the face of the deep flange with a large flat core is commendable and if the sand is rammed sufficiently hard behind the core it should not strain more than sufficient to compensate for the natural draft of the pattern.

"If oven and flask equipment are available the job may be made in a dry sand mold with a fairly reasonable assurance that the casting will be clean and smooth and true to dimensions. Also the job may be entrusted to any ordinary molder. In fact in looking over the blueprint and noting the severe specifications covering accuracy of dimension and surface appearence, I am of the opinion that the job *should* be made in a dry sand mold and thus avoid possible chances of rejection.

American Brass Foundry Practice

By Charles Vickers

Part II—Molding Small Loose Patterns

WHEN changes are made with every mold in a *side* of small, loose patterns, little if anything can be done to increase production. Such work may be made as profitable as any other if the castings are sold by the piece and not by weight. However, it is seldom that any one foundry will be confined to making this work exclusively, as it may be carried on along with other classes of brasswork which will absorb the greater portion of the metal that may be melted in a day's work.

Make Numerous Changes

Usually patrons requiring limited amounts of small brass castings will be model makers and inventors of small machines who have to make numerous changes while developing their ideas. Shops catering to loose work can expedite production by sorting such patterns with the idea of limiting to the greatest possible extent the number of molders working the rapidly changing sides. A side running for 6 molds straight will pay for a rammed-off match, and one for 12 or more molds will pay for both match and gate. Consequently, when enough patterns can be gathered to form a side running for 6 molds without a change, and another side can be formed running for 12 or more molds, it will be economical to keep these two sides separate instead of mixing the patterns indiscriminately.

The molder rams up a temporary match on which he arranges and beds in the patterns of the 12-mold side. This temporary match is used to ram up one mold which is put on the casting floor, *saving* the temporary match. He next turns his attention to the side for 6 molds and after making his first drag he rams a match of this before ramming the cope. This match after being sprayed thoroughly with water is set aside, while he finishes the first 6-side mold in the usual way. As the molder removes the patterns, he sets them in place in the rammed-up match, which previously has been dusted well with parting. This match makes the parting for the second and succeeding molds, and thus saves valuable time.

It will be necessary before starting to ram the drag of the second mold of this side to see that the patterns fit the match. Undoubtedly they will have to be rapped down lightly in the match to their proper parting lines, and the high parts on the match will require nailing so they will not break away. A little trimming and building up will be required, with a little firming here and there. However, it will not pay to spend much time on this match because of the limited run of the side. While the joint made by such a match never is perfect, the saving in time is well worth while. Six molds will be made in less than half the time that would be required if the parting of each mold was made individually. By the time the first metal comes the molder will have his 6-side molds nearly completed.

The first mold which should be cast with any suitable metal melted, must be the one first made on the 12-mold side, and as soon as cool, the castings are dumped and water-cooled. They are carried to the saw and the gate is sawed off carefully and saved. The sprue or vertical portion is sawed off, to within about an inch from the runner. This projection is then ground on the wheel to a blunt cone or knob which saves crushing by the sprue cutter, when pushing the latter through the cope. The gate is filed to remove unnecessary burrs, and it may also be drilled at the balancing point of its length, so the draw spike can be used to remove it from the mold. In this way a runner is produced that can be used to save the time of cutting the gates for the remainder of the molds.

Work Done Rapidly

By this time the molder will be ready for the 12-mold side of which 11 more molds are wanted. Having saved his first temporary match, he adjusts the patterns thereon places his brass *set gate* in the proper place and makes a drag. This drag is rolled over, match and all, of course, and the temporary match is removed and shaken out. The molder replaces the half flask on the drag just made and rams up another match, which when removed is duly sprayed and dusted and is ready to carry on for the other 10 molds wanted. The molding of this second side will proceed much faster than that for the 6-mold side because the gate cutting is eliminated, as is the firming and pressing by the fingers.

If this side runs for 25 or more castings without a change the match should be rammed up with new sand, after being faced with a mixture of new sand 20 parts, flour 1 part. While in use the match should be water sprayed every few molds to keep it moist so that it will not crack and break away. For a long run of loose patterns, every effort should be made to keep the match in the best of condition, for it is a tremendous time saver. When it is first rammed up on the drag of the mold care must be taken to have the bottom board bear perfectly on both the sand and the sides and end of the half flask.

Set Bottom Boards

If the bottom board of a match does not bear on the flask edges, the flask itself will sink when a drag is rammed on it, and the result of this is sunken drags. That is, the parting will be below the flask joint, and the sand of the cope will protrude correspondingly above the flask joint. This will result in *bad lifts* of the cope, and what is worse *drop outs* on the final closing of the cope. The reverse of this occurs when the bottom board fails to bear on the sand of the match. When the latter is rammed on, it will sink to a contact with the board. Then the parting of the mold drags will be high as compared with the flask joint, and the cope will be sunken.

Usually the parting lines of a loose pattern match will be irregular due to the shape of the patterns. If such is the case, nothing more can be done in regard to keeping the parting line level with the flask joint, than taking the precautions previously mentioned. However, it will happen when a side runs for 50 or 100 molds, which is unusual with this sort of brasswork, that a new match will have to be made. The molder usually does this

just before quitting time, by deducting his last couple of molds, which loss is made up easily with the new match the next day.

Sometimes a *side* will consist of cylindrical or circular bodies where each pattern has to be sunk to half its diameter in the match. In such a case a perfectly flat match results in which the face of the match lies in the same plane as the half flask joint. Now, if a rammed match could be kept in that shape it would result in the best output obtainable from such a side, but this cannot be done unless the original match is given a special treatment after a half dozen molds have been rammed from it. About that time more or less trouble will ensue with rough ill-jointed castings.

Restore the Level

This difficulty is removed by leveling the match. That is accomplished by first thoroughly spraying it with water but not enough to make it into mud. Next, it is dusted thoroughly with parting, and then a straight, level follow board is laid on the upper surface. Both board and match are rolled over without any slipping of follow board until the face of the match rests on the follow board. The half flask containing the match is rapped down until its joint rests on the follow board. Then using the butt rammers, the whole back of the sand part is butted lightly, but not hard enough to destroy the impressions underneath. However, the work must be done with sufficient completeness to bring the face of the match thoroughly into contact with the follow board underneath.

The butted surface is scratched over to destroy the parting made by the butt ramming and new sand is rammed lightly in place. A *bed* is made again for the bottom board, and the whole is again rolled over. The match face will be found to be perfectly level with the flask joint, but the impressions will be smaller and shallower and the patterns will require pounding down to place. Before doing this it will be advisable to dig out a little sand from the bottom of each impression. Such a match will not change its level for some time as it will last perfectly for dozens of molds. However, like all green sand matches, it has to be kept damp by regular spraying. Also, at night it should be covered with a well dampened cloth.

Interchangeable flasks should be used because the match can be made in a cope half which permits it to be lifted off the drag just the same as a cope. When it is not possible to use interchangeable flasks, it will be more difficult to keep a match in good condition, as the match under the rammed up drag is not held by pins. Consequently, the match is likely to slip when it is being rolled over. When such a match is to be removed from the drag, it should never be lifted straight up like a cope, because it inevitably will be destroyed. The way to lift it is to roll it off, by pressing one end down firmly with the left hand, meanwhile raising the other end like opening the cover of a book when it is lying flat on a table.

Irregularly-shaped loose patterns usually are made of wood, and as patterns, may represent many stages of completeness, from the well-finished and varnished work of a competent patternmaker to the home-made patterns whittled out by a jackknife. As many patterns as possible are included in a side and considerable skill is exhibited in *laying out* a side. Sometimes, one pattern may be gated from another and by that means every corner of the flask is utilized.

However, if the running of one pattern from another is carried to extremes, nothing will be gained by such practice. Assuming that a *set* gate is being used, its usefulness will not extend to the parasite patterns. These have to be drawn separately and a channel cut to the pattern to which they are to be attached. This must be done by hand, and too much of this work slows up the production to the point where the advantage of crowding in another pattern is lost.

Moistening Assists Drawing

Each pattern being loose, has to be drawn individually and before being drawn each one has to be swabbed or painted around with water to firm the sand edges so they will not tear as the pattern is drawn. This is carried out by brushing on water with a regular brass molder's camels hair brush. This is a round brush, about 1¼ inches in diameter, with bristles set in a quill. It is used like a paint brush on the sand around the patterns. Usually, the molder works with the brush in one hand and the water can in the other into which the brush is dipped at intervals.

This operation swabbing the joint of a side of loose pattern has to be done carefully so that too much water is not used. Sometimes the molder dispenses with the water brush and instead he sprays the drag side. This is not so good because the patterns become wet and the moisture seeps into the sand of the joint reducing some of it to mud which adheres to the patterns as they are drawn, and produces a decidedly rough joint on the castings. After the patterns have been swabbed they are ready to be drawn and this has to be done one at a time.

This is carried out by driving a small spike into the pattern at a balancing point. The spike must be sharp as a needle to pierce the pattern under a gentle blow. If the spike is dull a considerable blow will be required to make it enter the wood, and this pounds the pattern down. In that case the casting will be thicker than the pattern, and may be rejected. As the patterns are drawn they are tossed into a sieve where they partly dry and reduce the time required to clean them before being put into place in the match to commence the next mold.

Leaves Patterns in Match

Sometimes the patterns of a loose side can be drawn by dumping as it is called, but this only is permissible when the contour of the patterns is similar in both cope and drag as in the case of cylindrical or circular bodies, such as lever handle plugs. When the patterns are ready to be drawn, it is best to swab the sand lightly around the patterns instead of spraying them. They are rapped lightly to loosen them and then the match is closed onto the drag. Both drag and match are rolled over and the drag is lifted off the match in the same manner as a cope, leaving the patterns in place on the match all ready for the succeeding mold.

Swabbing may be dispensed with if a thin film of extra dampened sand is screened lightly onto the face of the match before ramming the drag. This film of extra damp sand should not be sufficiently deep to cover the patterns, but merely enough to lie about a sixteenth inch deep on the match and thus surround the patterns. The regular preliminary layer of screened sand is placed on this layer, the sand is tucked, and the drag rammed as usual. This film of damper sand dispenses with the need of swabbing around the patterns. Therefore, the latter are not wetted, but after being dumped into the match are ready for use again. Also, the drag of the mold is left with a clean cut impression of the lower half of the patterns. This method though, is only applicable to castings of round or cylindrical shape.

Alloys mostly used for casting loose work are red brass of the copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent; lead, 5 per cent family, which includes copper, 85 per cent; tin, 4 per cent; zinc, 6 per cent; and lead, 5 per cent and copper, 85 per cent; tin, 4 per cent; zinc, 5 per cent,

and lead 6 per cent. The last mentioned of the three alloys has the preference as it has a slightly redder shade and machines more easily. These castings, as a rule are not used in connection with pressure of water or gas, but are used when all that is wanted is a nice appearing and easily machined alloy, free from casting difficulties. Alloys cheapened by a high zinc content are not economical for this class of work, as the zinc smoke is likely to deface the castings, resulting in considerable loss.

Cost of the metal is a small detail compared with the cost of making such castings. The purchaser may be called upon to pay several dollars per pound for such work, and he demands castings, clean and bright as a new dollar. Molders skilled in such work are needed to produce this type of brass castings and on the average it will be found there is little difference in the day's work obtainable between different foundries. Therefore, the selling price should not fluctuate to any great extent.

Use Different Gates

Sometimes instead of the brass gate described, a white metal gate is made. This gate is used in cases where the side runs for a considerable number of molds. The brass gate is used when only comparatively few molds are wanted, and on the conclusion of the job it is scrapped. The white metal gate may be preserved for future service, so it is made to fit a set of patterns that have to be molded periodically, but which never is ordered in quantities sufficient to justify making a pattern plate. To make a white metal gate for such patterns, a mold first is made and the cope lifted, but the patterns are not drawn in the drag half. Only the runner stick is drawn and the gates are cut up to each pattern. Whether the latter are of wood or metal makes no difference in the result.

This runner gate is given special attention to have the mold as smooth and complete as it is possible to make it, and when it is finished a sprue is cut through the cope, usually on top of the ball or knob that should be on the pouring end of the gate in the cope as a guide for the sprue cutter. This sprue should be no thicker than a common lead pencil, and it is funneled out a little on the top of the cope. Then the cope is closed over the drag with its patterns intact and the mold is inclined to bring the sprue end highest. After being weighted the mold is poured with white metal through the small sprue.

Should the shop be in possession of facilities for drilling a draw hole in the white metal gate, this is done, but if not, a round sliver of soft wood of the right diameter is pinned in the bottom of the runner at the proper point for balancing so that the draw spike can be driven into it to facilitate the withdrawal of the gate. This wooden core usually is left in place in the castings. Wood does not burn away to any extend because the pouring temperature of the white metal must be too low to carbonize wood, otherwise the wooden patterns, up to which the metal runs also would be burnt. As it is, all that happens to them from contact with the molten metal will be a slight roughening of the varnish which is removed by sandpapering. Outside of this the patterns are not injured in any way, provided the metal has not been poured too *hot*.

Pouring temperature of the white metal is gaged by stirring with a small stick of soft wood. If the wood bursts into flame the metal is much too hot and is allowed to cool to the point where it does not carbonize the wood even slightly. Usually the white metal is melted in an iron ladle, and is poured from the same ladle. An alloy of 50 per cent tin and 50 per cent lead has advantages for this purpose because it has a low melting point and it easily is used up again. It can be used to make ounce metal or any other alloy containing tin and lead.

A harder alloy than the above contains 20 pounds of tin; 20 pounds of lead; and 5 pounds of antimony. In making this alloy the lead should be melted first and be brought to a red heat. Then the antimony should be added and dissolved, after which the tin is added. This alloy also may be used for alloying to make a red metal, but the proportion used should not add more than 1.5 per cent antimony to the brass. If the 85-5-5-5 alloy is used, its tin content may be cut in half, when 1.5 per cent antimony is added. However, this alloy is not as strong as the regular 85-5-5-5 alloy without antimony, but it can be and has been used for red brass castings in which strength is not so important.

The July meeting of the New England Foundrymen's association was held July 10, at the Wampanoag Motor club, Taunton, Mass. Following a lunch, the members indulged in various sports. The dinner in the evening was informal. It was the first time in the history of the association that a meeting has been held at Taunton. The August meeting of the association will be at Providence, R. I.

Railway Equipment Makers Plan Merger

The National Malleable & Steel Castings Co., Cleveland; the Symington Co., Rochester, N. Y.; and the Gould Coupler Co., Depew, N. Y., controlled by the Symington Co., are about to be consolidated, it is reported. Symington owns about 95 per cent of the stock of the Gould Coupler Co. National Malleable's iron casting plants are in Cleveland, Chicago, Indianapolis, Toledo, O., and East St. Louis, Ill., while steel castings plants are at Sharon, Pa., and Melrose Park, Chicago, Ill.

Gould Coupler Co. makes freight and passenger cars and locomotives and owns the Gould Storage Battery Co., Depew, N. Y. Symington acquired 91 per cent of the Gould Coupler Co. stock in 1925. The earnings of both companies have improved recently due to heavier buying of railroad equipment.

Henry F. Pape is president of National Malleable & Steel Castings Co.

Entertain A. F. A. Party

Members of the American Foundrymen's association party attending the Third International Foundrymen's congress, who made the post convention tour through Belgium and France, were entertained at dinner in the Restaurant Webber, Paris, on June 27 by the Association Technique de Fonderie de France. A. Damour, president of the association, was toastmaster and the address of welcome was made by E. Ronceray. S. Wells Utley, past president of the American Foundrymen's association responded and short speeches also were made by Messrs. Plichon and Erb. A number of French foundrymen who attended the Second International congress in Detroit in 1926, were present, including Messrs. Ronceray, Ramas, Magdelenat, Montupet, and M. Primet and son. The American Foundrymen's association was represented by Messrs. Erb, Utley, Hageboeck, Giboney, Hanley, Weber, Snyder, Grede, and Dodge. Dancing followed the dinner.

The party also was entertained informally at Liege, Belgium, on June 19, by the Belgium foundrymen. The delegates were met by Marcel Remy, president, I. Lamoureux, vice president, Rene Deprez, secretary and numerous members of the Association Technique de Fonderie de Belgique. Luncheon was served at the Hotel de Suede and the party then was taken for a drive past the old forts to Spa. The delegates boarded the train for Cologne at Pepinster.

SAFETY Must Begin at the Top

Workmen Need Instruction, but Foremen and Heads of Departments First Must Be Grounded Thoroughly in All Phases of Safety

By F. H. Elam

SAFETY in the foundry, as in other manufacturing operations, can be achieved only by the combined effort of all the personnel. Desire for safety accomplishment must start with the managing head—whatever may be his title, owner, president, manager, etc. The measure of success will be in direct ratio to the degree that this *will for safety* is projected down through the organization to the youngest apprentice or tag boy.

It would seem that the possession of usual humanitarian instincts by managing heads is not enough. They also must be convinced fully that accidental injuries in the course of employment are an unjustifiable waste and one of the most important intangibles in high production costs.

Should Begin Early

This last realization usually is necessary to cause due consideration to be given to the unpleasant effects of injuries and the worthwhile possibilities of the prevention of injuries.

Prevention of accidents and consequent injuries should begin with the planning and layout of the foundry buildings and yard, installation of equipment, laying out of the various molding floors, paths by which production will travel through the various departments, cleaning and shipping departments, and other operations which will be mentioned later.

Probably the majority of foundry buildings now in use are not ideal with respect to safety under present-day conditions if they ever were, and it is easy in the usual rush of providing new buildings or a new foundry to overlook a number of essential features that would be aids to safe operations. These deficiencies, old and new, usually mean that management makes the best readjustment possible from a production point of view, but too often safety considerations are neglected and put off until a more convenient time. This is a serious mistake because production without safety is poor economics.

Purchase and installation of new equipment always should be given careful and continued study to foresee and prevent injuries, especially during the time the equipment is being installed, broken in, and while the workmen are getting acquainted with its operation. Most new equipment is purchased, but the work of installation frequently is done by the foundry mechanical department. Frequently work is attempted that is practically new to the whole force from the plant engineer down to the laborers. All hands are so interested in the work that they frequently overlook simple but necessary precautions taken by men regularly engaged in work of that character. Excavations are made without proper shoring, building columns are undermined without adequate supports and structural materials are hoisted with inadequate lifting devices. The whole procedure is a series of gambles with fate; with lives and limbs for pawns. At such a time the manager, who thinks there are other and more important duties than being continuously on the job, and acting as safety supervisor, is likely to experience a sad awakening.

Who Is Responsible?

MANAGEMENT must assume responsibility for safety in the industrial establishment. The employe has nothing to say regarding the design of buildings, the layout of machinery and other types of equipment, and the methods of operation. Unless the problem of safety for the worker is given the proper attention, accident costs may place the establishment in a precarious position. This article, which is from a paper presented at the Chicago meeting of the American Foundrymen's association, discusses a few of the considerations essential to success in any safety movement. The author is manager of the casualty department, American Steel Foundries, Chicago.

Needs Careful Watching

When a new piece of equipment, apparently fully guarded, is ready for operation, supervisors who are watching its performances in production should be especially watchful to see that it is operated safely. Workmen may want to remove and lay guards aside giving as excuses that adjustments have to be made and replacing guards takes too long. Guards furnished with the equipment may not work properly in the new service or location.

With new molding units care must be exercised to see that dangerous situations do not develop in serving the unit with sand, facing, flasks, etc., and in routing finished molds away from the units to the pouring floor. Workmen trying to get production in spite of imperfection in the service may use too much haste, or may try to use too much physical force and get injured.

Dangerous possibilities inherent in a new piece of equipment or in its location usually are not all discovered at once. These possibilities for injury

are not anticipated by a close study and thus prevented, but are allowed to become known through the medium of tragic injuries to the workmen.

Dangerous imperfections in operations and practice are soon known to the workmen, but usually nothing is said because they do not want to be considered alarmists or kickers. They would readily tell what they have observed and know if asked by a foreman.

The fact that injuries are avoided by dexterity or luck is a bad situation and should not be tolerated by management. That this situation exists is borne out by the study made by the Travelers Insurance Co., Hartford, Conn., as set forth in the *Travelers Standard*, January, 1929. From an analysis of 50,000 injuries it is shown that for each major injury, there are 29 minor injuries and not less than 300 accidents that do not cause any injury, but which have all the inherent potentialities that the one accident had that caused the one major injury.

Is Not Excusable

While these facts probably never before have been stated as clearly, yet unconsciously most workmen have known that the ratio of injuries to accidents was small and probably have lulled their fears with the thought that the law of averages as they dimly understand its workings would enable them to escape injury if they were lucky. Such a mode of thinking by workmen may be excused or condoned, but such thinking by management is inexcusable.

In a less enlightened day, workmen facing this unknown 1-29-300 hazard sometimes developed considerable pride in their supposed skill in escaping the dangers of their particular craft or calling, feeling that such escape entitled them to be considered master workmen. As a matter of fact, it was not always the best workman who escaped.

Consider what this mode of thinking has cost. First, the major injury with its suffering, loss of earning power, and loss of production. Then the tremendous loss of production occasioned by the other fellows working with one eye on production and the other eye on the *Jack be nimble, Jack be quick* proposition, if they were to escape injury.

The foundry with operations or processes that require men to constantly flirt with danger in the course of their employment had better correct the situation before casualty compensation costs wrecks the financial structure.

One thing that will do more than any other to reduce accidents with the least expenditure of money is to clean up the shop, then keep it clean. This has been proven so often that it cannot be questioned successfully as it was once.

A clean shop also reduces foundry costs.

An old-time foundry superintendent when asked why he did not clean up his shop, said that "a clean foundry was a foundry without enough work to do." Most foundrymen know better now, but there are still a few of this tribe who should take a course in good housekeeping.

A clean shop means every department clean. If you are short of room, clean things up a bit cleaner, then at least you have some of the room needed plus greater ease in working, and at the same time you will reduce accidents.

After things have been cleaned up for a time, the suggestion that a concrete walk down through the foundry and out to the office or a concrete floor in the cleaning room, or a few flowers beside the walk from the gate to the shop won't sound a bit foolish or impossible.

Practically every foundry today is operating under some state compensation law, and that means the payment of compensation for injuries arising out of and in the course of employment. Frequently, it also means payment for physical conditions, such as hernia, lame back, etc., that did not arise, neither were they received in the course of employment.

Compensation Laws

What a relief and satisfaction it would be if all injury cases were clean cut disabilities that came under the specific schedules of the compensation act, with known or readily calculated amounts of compensation so that we could say authoritatively to the injured workman, you will be paid so much and no more. Contrast this with many present cases, coming under the various indefinite classes that may require that compensation be paid for years and, in some instances, for the life of the injured. All of these last type of cases invite the potentially dishonest workmen to see just how long they can extract compensation and refrain from work. Paraphrasing the Psalmist, we are tempted to exclaim: "In my haste I said all men are (liars) malingerers." However, workmen's compensation is here to stay. We should make the best uses possible of this instrument of adversity. We believe it can be made an important aid to safety.

Comparatively few foundries are large enough to warrant carrying their own casualty insurance risk. Casualty insurance is bought from either a state fund, a mutual company, or a regular casualty insurance company. The premium paid usually reflects the accident experience of the insured with adjustment of premium rates from time to time as a result of that experience. Insurance companies offer their clients valuable services through their inspection departments, looking to the elimination of hazards, and the reduction of accidents in the foundry. However, a tendency exists to pay the premium and then let the matter of trying to reduce accidents and rates rest until it again falls due.

To get all the safety benefits the employer should keep a close tally of the compensation, medical and hospital payments made by the insurance company to his injured employes, first, to know that the payments are prompt, second, to know that they are fully as liberal as the law requires, and, third, to apportion the payments to the departments where the accidents occur.

Show Department Heads

As the payments are made, the foreman of the department and his assistants are reminded continually of at least two unpleasant features of an injury: An accident may occur in only a second of time, but the results to the injured and to the employer may extend over a life time.

Under usual conditions payment of an insurance premium every 6 to 12 months fails to impress anyone except the treasurer. However, when it is known what failure to be safe is costing by departments, and that the burden is accumulative and growing, and when it also is noted what the percentages are over and above compensation and medical payments that the insurance company finds necessary to provide to carry on, then the facts become impressive, and should be a spur to accident prevention. If such a record is kept and then translated into the resulting added cost per ton of good castings, it becomes impressive in a new manner.

The actual out-of-pocket cost of injuries does not complete the story. The reduced production of workmen when partially disabled, the cost of replacing those totally disabled, the cost of stoppage of operations by a large number of workmen when a serious injury occurs, should be a further incentive to accident prevention.

Up to this point nothing has been said about plans to educate workmen in safe working practices and thinking. We have laid too much stress on the part that the workman has in the

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Molds Melting Pot

Dry Sand Core on Bottom Facilitates Work

By J. H. Eastham

UNDER ordinary conditions the receipt and execution of an order for the melting pot shown in the accompanying illustrations would excite no comment. Without a pattern, the mold would be swept in loam, dried, assembled, cast and approximately on the fourth day after the receipt of the order, the cleaned casting would be delivered to the customer.

In the particular instance to be described, conditions varied from the ordinary. The order was taken by a small jobbing shop without any facilities for loam molding. The customer waited until the brickwork and other fittings were erected before he supplied the foundryman with a rough sketch of the desired casting. This was on Monday afternoon and he wanted the casting delivered Thursday morning. The foundryman was given an absolutely free hand to make the mold in any manner he pleased.

Immediately after the interview three wood drags 12 inches deep, 4 feet 6 inches square, and made from 3-inch lumber, were assembled to form a drag 3 feet deep. Rough slabs were nailed on the outside to increase the rigidity. A suitable cope was overhauled. The three center bars were replaced by iron bars cast in open sand molds that afternoon.

The bottom plate shown in Fig. 7 also was molded and cast in open sand the same day. An opening was formed in the center and lugs were placed at the corners so that the plate might be available for other miscellaneous jobs in the future. The plate was vented freely.

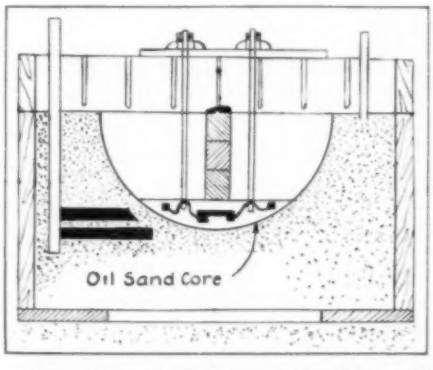


FIG. 1—THE BOTTOM CORE WAS ANCHORED FIRMLY TO THE COPE

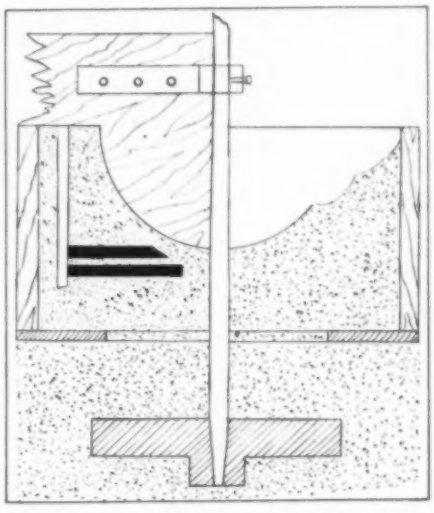


FIG. 2—THE RUNNER CORE WAS FILED TO FIT THE SWEEP CONTOUR

A rough core arbor equipped with three loops also was cast, cooled as soon as possible with water and immediately utilized. A small combination sweep and spindle served to form the desired core slab. A headless nail was driven part way into the bottom of the wood spindle. The other end fitted in a small hole drilled in the coreplate. An oil sand mixture was used and the opening left by the spindle was plugged before the core was placed in the oven.

Other activities during the afternoon included the making and fitting of a combination sweep designed to form the outside and inside faces of the mold. The main sweep was fitted to a 2-inch spindle which in turn was erected from a suitable socket bedded below the floor level. Thus everything was ready for an early start Tuesday morning.

The bottom plate was bedded level on the floor in a position to bring the spindle plumb and central. The wood flask then was set in place and adjusted in such a manner that the horizontal upper face of the sweep just touched the joint on all four sides. Floor sand was rammed in the flask up to the bottom of the sweep. An oil sand runner core taken from the stock pile was filed at one end to fit the contour of the auxiliary part of the sweep attached temporarily for the purpose.

An upright runner stick was adjusted in place at the outer end of the runner core. The auxiliary piece was removed from the sweep and after a sufficient quantity of sand had been rammed in the drag, the sweep was pulled around to form an impression against which to ram the cope. The sand face in this instance corresponded to the inside face of a pattern, if a pattern had been used.

Spindle and board were lifted out of the mold. The hole left by the spindle was stuffed with waste and the face of the mold was covered with wet parting sand slicked to a smooth surface. The dry sand core referred to previously was lowered into place at the bottom of the mold and adjusted in position for the three lifting bolts to clear the bars in the cope. With the cope in position, cast iron blocks were built up from the core and wedged under the iron bars to prevent the core from *straining* upward and thus increasing the thickness of the casting, under the pressure exerted by the molten iron at the time of pouring. A hook bolt attached to each of the loops in the core, projected about 4 inches above the level of the top of the cope. The mold at this stage with a longer gate pin and one of the risers in place is shown in Fig. 1.

Ramming the cope was a simple operation. The dry sand core served

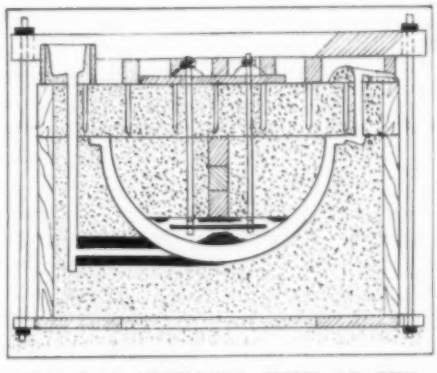


FIG. 3—A SECTIONAL VIEW OF THF FINISHED MOLD

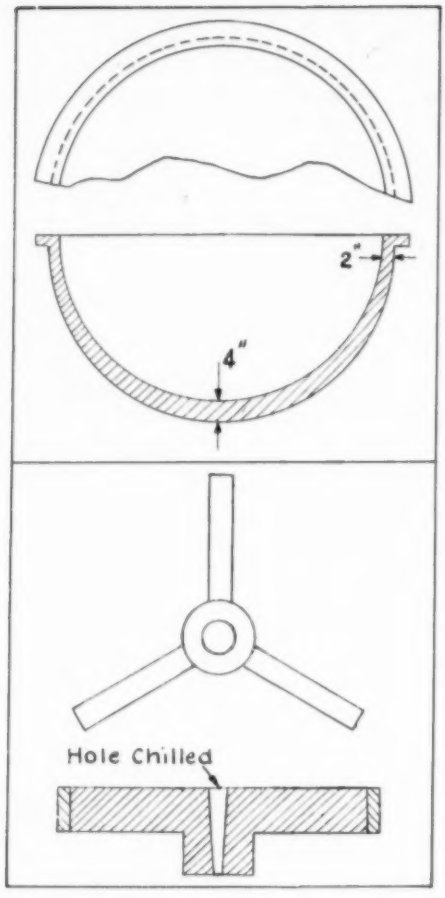


FIG. 4—A ROUGH SKETCH WAS SENT TO THE FOUNDRY. FIG. 5—THE BEARING IN THE SOCKET IS CHILLED

as a base and support for the green sand hanging body, approximately 18 inches deep and 3 feet in diameter. A single row of rods was employed to reinforce the sand in this part of the cope. A single row of gaggers was sufficient to hold the sand in the flat part above the flange. By late Tuesday afternoon the cope was ready to be lifted with the hook bolts pulled up firmly by nuts supported on plates laid on the cope bars. The cope might have been lifted that night but that would produce a dry surface to be finished in the morning, an undesirable feature.

On Wednesday the cope was lifted from the drag and placed on suitable trestles where the surface was finished in the usual manner and covered with plumbago rubbed on by hand.

Sand corresponding to the casting thickness was removed from the drag. An additional thickness of 1-inch also was removed and replaced with facing sand to insure a clean skin on the casting. The drag sand was vented with a wire down to the bottom plate. Then the spindle and sweep with the auxiliary piece on the edge, were adjusted in place. This auxiliary piece corresponded to the section of the proposed casting wall. The sweep was pulled around and necessary adjustments made on the face of the mold until a smooth uniform surface was produced. For added security a few nails were driven into the sand in the vicinity of the gate and around the flange.

Plumbago was rubbed over the face of the mold followed by a molasses water spray. An oil torch was employed to slightly skin dry the surface and thus reinforce it to resist the heat and weight of a large body of metal. The cope was tried on and off and the metal thickness space in the mold was checked by a number of clay balls in the usual manner. After a final cleaning the cope was replaced and the mold was bound firmly together by bolts which extended from the bottom plate to two binders laid on top of the cope. This and other details of the completed mold are shown in Fig. 3.

The casting was poured Wednesday afternoon and stripped about two hours later and, still hot was shipped Thursday morning according to schedule. The iron mixture contained 20 per cent steel and the analysis of the iron in the casting showed: Silicon 1.80 per cent, sulphur 0.06 per cent, phosphorus 0.20 per cent, manganese 0.65 per cent.

Safety Must Begin at the Top

(*Concluded from Page* 626)

prevention of accidents. Before the phrase *Safety First* was coined and the staggering job of obtaining it was unloaded on the safety inspector, who had the job of accident prevention? What did the laws of the land say about it? In plain language, they said that the master must provide a safe place for the servant to work.

This law also applied to the master's agent, that is any person to whom the master had delegated his authority to oversee and direct his workmen, and whom the workmen were in duty bound to obey; superintendents and foremen of all grades in degrees. Oversight and direction to obtain production also included oversight for safety the same as it should now.

All foremen or supervisors have not failed in this respect, but in a large measure the tendency has been to let supervisors step out from under this duty. The concerns that are making the most progress in accident prevention are the ones that are holding all grades of supervisors to a strict accountability. And why not? Do the workmen have anything to say about planning the buildings, designing the equipment, laying out the floors, routing the material through the various departments, etc., etc.? They do not. Management does, and management must be held accountable for accident prevention in all matters relative to the foregoing.

Regarding the training of workmen in accident prevention, the problem resolves itself down to the simple proposition of a proper exercise of authority and an enlightened leadership. American workmen, native or foreign born, willingly recognize authority and the need of wholesome discipline, and where these things are combined with leadership, workmen are easy to instruct in all things pertaining to their work, including safety and its observance.

Returns from Europe

Merton W. Zeman, sales manager, machine division, Osborn Mfg. Co., Cleveland, has returned from Europe. He was accompanied by William Rawlinson, managing director, J. W. Jackman & Co., Manchester and London, England, English representatives of the Osborn company. Mr. Rawlinson will inspect the plant of the Osborn Mfg. Co. and will visit foundries in which that company has installed machinery.

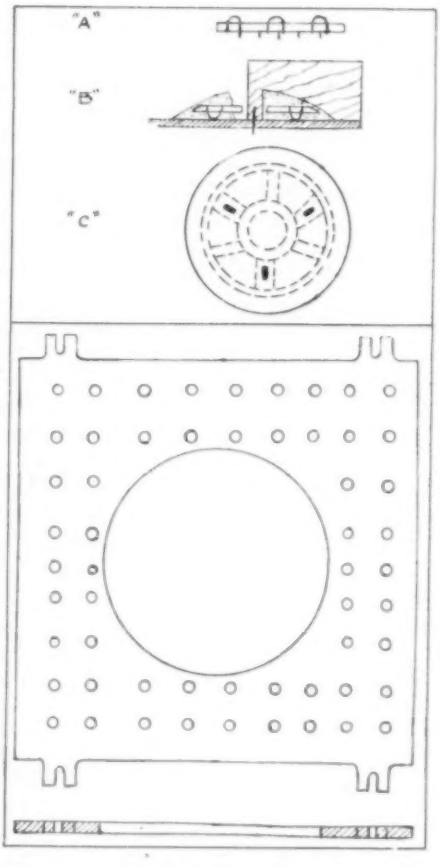


FIG. 6—*A*—THE CORE ARBOR. *B*—EQUIPMENT AND METHOD OF SWEEPING THE CORE. *C*—VIEW OF FINISHED CORE. FIG. 7—CAST IRON BOTTOM PLATE MADE IN OPEN SAND MOLD

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Discuss Cast Iron Testing

New Methods of Testing Cast Iron. Bulletin of the Association Technique de Fonderie, Paris, February, 1929.

A comprehensive review of the question of testing cast iron is included in this issue. The French association bases its arguments on the investigations of Fremont and Portevin, and emphasizes the necessity of employing test pieces taken from the casting itself. It favors the use of the Fremont shearing test. The review starts with a historical retrospect of the test bar question, from the paper presented by Fremont before the Academie des Sciences, and the papers presented at the Liege convention in 1921, to the discussions that have taken place on the subject, by international correspondence or through the technical press of France, Great Britain, Germany and America, until the end of 1927.

This review is followed by papers on "The Study of the Resistance of Cast Iron Obtained From the Shearing Test," and "The Punching Test on Cast Iron," by Doctor Rudeloff, Berlin; a paper on "The Problem of Test Bars—Recent Progress" by J. G. Pearce, and Le Thomas' paper, presented at the second International Foundry congress in Detroit in 1926. A short bibliography completes the publication.

Electric Devices Save Labor

Applications of Electricity in the Foundries, by J. Negre. *Bulletin of the Association Technique de Fonderie*, Paris, April, 1929.

There are numerous instances in which electricity may be used in foundries, and the author examines in particular three cases: magnetic separation, lifting and handling by magnetic hoists, scientific lighting. He shows that magnetic separation should be applied in every foundry. It is a source of economy, not only from the standpoint of cleaning sand, but also because it permits of the recovery of scrap iron. Concrete examples are given, showing how the equipment pays for itself after a comparatively short time. Considerations on the choice of a separator are presented, and a short description is given of magnetic pulleys, which can be used where a sand-handling plant exists, and magnetic drums.

Dealing with magnetic lifting devices, the author says that it is fallacious to think that these are applicable only to large installations. The electric magnet is an ideal equipment in foundries large and small, because it saves time and labor, facilitates the handling of hot loads, and can be used to lift most of the materials that are seen in a foundry. It is only recently that electric lighting in works has been studied scientifically. Calculations are necessary, because it has been proved that the increase in the power of a source of lighting does not necessarily improve the working conditions of a shop. A lighting scheme properly studied enables better lighting to be obtained without additional expense. The man works better when he has proper lighting and there is less risk of accidents. One of the main things to guard against is the use of dazzling lights. Various lighting appliances are considered, and the author endeavors to show that it often is sound economy to buy good equipment, even at a comparatively high price. A brief sketch is given of the theory of lighting in industrial works.

Removes Cores With Water

Removing Cores Hydraulically, by L. J. Gouttier. *La Revue de Fonderie Moderne*, Paris, May 10, 1929.

The author points out that little has been published on the practical results of hydraulic methods of cleaning castings. He summarizes the article by James Prendergast in THE FOUNDRY, Nov. 15, 1928, and an article by Dr. Ing. Max Maier in *Die Giesserei*, March 1, 1929. Dr. Maier's article describes hydraulic equipment at the foundry of Fritz Muller at Esslingen. Water is delivered through a nozzle of 0.20 to 0.25-inch in diameter at 710 pounds pressure and at a rate of 40 gallons per minute. The equipment, with one nozzle, can clean 300 tons of castings per month. Comparing the two systems, M. Gouttier points out that the German system uses ten times less water than the American one. On the other hand, the workman is protected better in the American method.

Describes Multi-Tuyered Cupola

Comparison of the Principle of the Poumay System With That of Previous Regenerative Cupolas, by M. Poumay, Jr. *La Revue de Fonderie Moderne*, Paris, Feb. 10, 1929.

Attempts have been made to construct cupolas with one or two rows of tuyeres above the zone of fusion to obtain the reaction $CO + O = CO_2$ and remedy the formation of carbon monoxide. The object is to get as near as possible to the complete reaction $C + 2O = CO_2$, which is exothermic. Poumay claims that it is impossible to obtain this reaction without first obtaining the formation of carbon monoxide, when combustion takes place in air and not in pure oxygen. In front of the normal row of tuyeres, the carbon and the oxygen do combine and form CO_2, but this CO_2, when passing through the zone of fusion, combines with the carbon and gives CO, this reaction absorbing heat.

The effect of adding a complete row of tuyeres above the zone of fusion is to repeat the reactions which already have taken place, and create a second zone of fusion. The melted iron coming from this upper zone is said to solidify when it comes in contact with the non-melted materials and choke the cupola. Poumay claims to avoid the massive action which causes this second zone of fusion. Instead of one complete row of tuyeres above the normal zone of fusion, several rows of tuyeres are used, the number of the tuyeres in each row and the number of the rows themselves being determined according to the hourly capacity of the cupola, and to obtain gradually the final reaction $CO + O = CO_2$ without creating a second zone of fusion. Furthermore, it is claimed that the normal row of tuyeres is arranged so as to give a rotary movement to the ascending gases, so that a more intimate mixture with the air is obtained above the zone of fusion. The mixture is said to be more combustible because it is more homogeneous.

Controls Casting Progress

Control of the Progression of Orders in a Jobbing Foundry, by M. Hymans. *Bulletin of the Association Technique de Fonderie*, Paris, March, 1929.

Hymans describes a system that he has applied in certain foundries in three different countries, including the Fonderies de Brousseval in France. The system is a modification of Gantt's diagram, and its principle is based on the use of a board, divided vertically into the days of the month, and on which movable horizontal strips indicate the progress of work.

The author defines progress of the orders, the faculty given to the management to know at any moment the state of progression of the various orders in hand, and the possibility of accepting new orders and forecasting their date of completion. This involves complete accord and liaison between the various departments of the foundry. In many foundries these departments work in an unconnected fashion, which results in considerable loss of time. When an order for a casting is received, the various processes of manufacture should be studied completely and the availability of the necessary equipment ascertained, before the work is started. The operation of the board, with its movable strips, is explained in detail, together with the administrative and controlling work that goes with it. It is stated that the use of this system at the Brousseval foundry has influenced operations materially in the direction of greater efficiency. The system also enables the management to prevent unavoidable delays of shipments and advise the customer in good time. Reference is made to the work of the American investigator, C. E. Knoeppel.

The Shakeout

DAN M. AVEY, Editor
PAT DWYER, Engineering Editor
EDWIN BREMER, Metallurgical Editor
FRANK G. STEINEBACH, Managing Editor
CHARLES VICKERS, Nonferrous Editor
NORMAN F. HINDLE, Assistant Editor

A ¶ Increases Usefulness

AT ITS recent meeting in Atlantic City the American Society for Testing Materials adopted methods for speeding standardization procedure which should increase greatly the service and value of that important technical organization to industry in general. Under the new arrangement, a recently appointed committee on standards may accept for publication and distribution, proposed tentative standards and proposed modifications in existing tentative standards in the interim between annual meetings of the society.

SPONSORS of the change point out that other advantages will be realized in addition to greater speed in presenting standardization proposals. A more flexible procedure will result since committees will not have to wait until the annual meeting to present reports, a custom in vogue since the organization of the society. The time lag which often exists between the completion of a particular piece of work by a committee and final action of the membership assembled at the annual meeting will be eliminated. Committees will feel a greater incentive to complete their work when they know that the report may be published immediately. Early publication of the reports will give members of the society a greater opportunity to review the work of the committees and probably will be reflected in greater volume of constructive criticism.

THE change in procedure will not jeopardize the safeguards which have been placed around the establishment of an A. S. T. M. standard. Only new and modified tentative standards will be review by the committee on standards. A tentative standard so promulgated between annual meetings will be brought before the membership at the following annual meeting, where it will be subject to amendment in the usual way and normally will be continued as tentative for another year. As heretofore, a formal vote of the society is necessary for the final adoption as standard of a tentative standard. However, the methods adopted for expediting standardization work will enable the society to keep pace with the rapid changes taking place constantly in modern industry.

C ¶ Apply Rules to Business

CHARLES M. SCHWAB, recently quoted the following rules for making permanent the present prosperity:

"Pay labor the highest possible wages. Prosperity is related intimately to a liberal wage scale.

"Treat labor as a business partner.

"Conduct business in the full light of day. Public confidence and suspicion may be separated only by a door.

"Remember that the law of supply and demand is inexorable.

"Live and help live. Even prosperous industries cannot afford to have the backward industries too far behind the procession.

"Welcome new ideas.

"Never be satisfied with what has been done. Complacency does not make progress.

"Operate business on the most economical basis possible. Price cutting, over-expansion and uneconomical methods of distribution are just as harmful to business and the public as are price fixing, monopolies and rebates.

"Look ahead and think ahead. It is easier to avoid depressions than it is to cure them.

"Work upon the fundamental purpose that business is to promote the happiness of human beings."

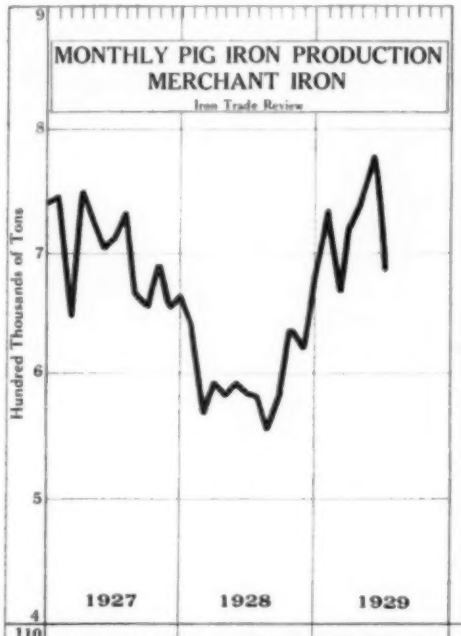
THESE rules are applicable to every business and foundrymen would do well to study and apply them. The rules embrace several facts that have led to the formation of groups in the industry. Price-cutting, over expansion and uneconomical distribution methods are some of the things that have led associations to fight to bring about a stabilization of the foundry industry. A better knowledge of foundry costs together with a closer study and understanding of business conditions will do much to give prosperity to the industry.

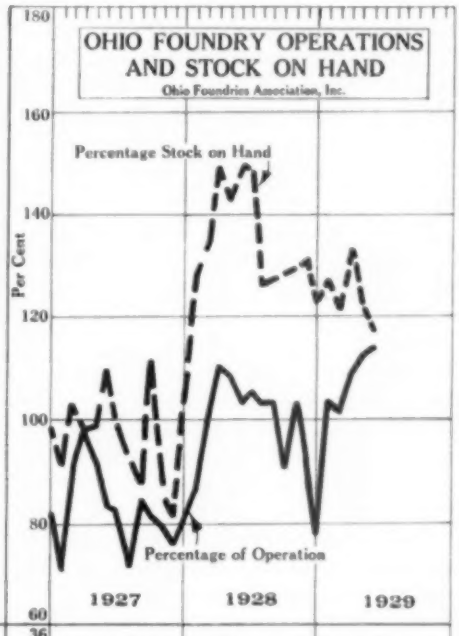
Trade Trends in Tabloid

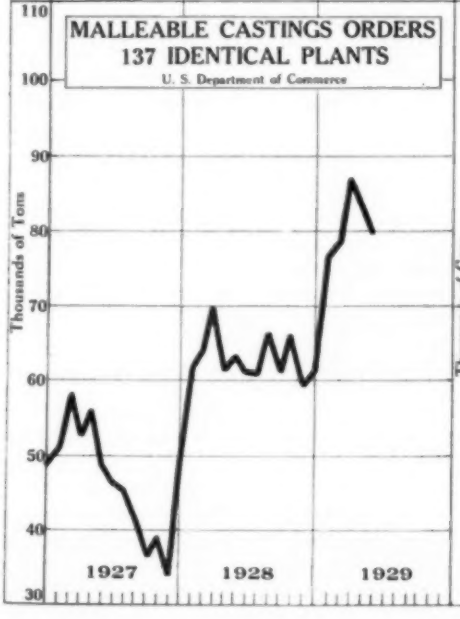
WHILE a slight recession is noted in foundry operations, production of castings continues at a rate considerable above the average for the summer period in recent years. Slight curtailment in the automotive field has resulted in some slowing of gray iron and malleable foundries producing castings for that industry. However, the situation probably will be improved in the near future when a number of automobile producers will come in the market with new models. Reports from steel foundries show high operations and good prospects. Railroad equipment buying is holding up remarkably well in view of heavy purchases thus far this year. During the first half of 1929 the railroads bought over 60,000 freight cars compared with a total of 45,000 cars during all of 1928. Although slightly under the record for May, pig iron production in June was the highest ever for that month. According to *Iron Trade Review*, the average daily production was 123,853 tons. The total output for the month was 3,715,583 tons. Merchant iron produced in June totaled 687,188 tons. Average nonferrous prices for June, according to New York quotations in *Daily Metal Trade* follow: Casting copper, 17.35c; electrolytic copper, 18.00c; Straits tin, 44.269c; lead, 7.000c; antimony, 8.834c; aluminum, 23.900c. Zinc prices averaged 6.657c, East St. Louis, Ill.

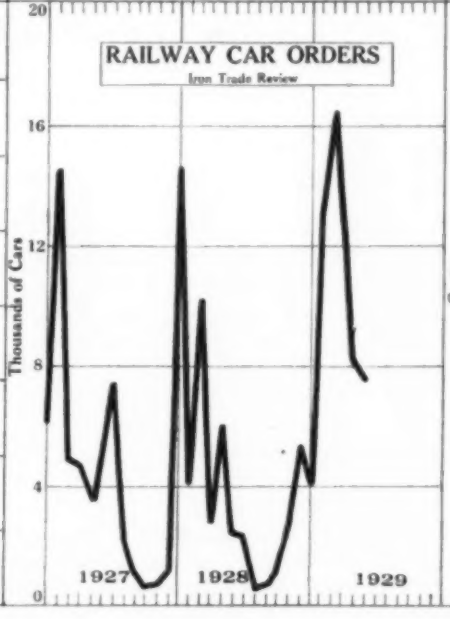
RAW MATERIAL PRICES
July 6, 1929

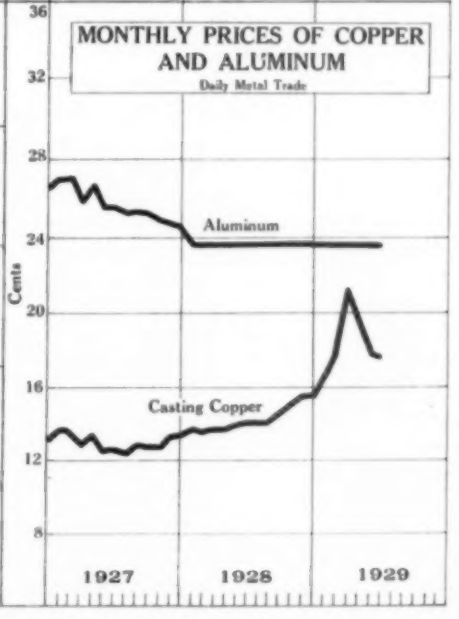
Iron	
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	15.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	22.26
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	18.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville foundry coke	$3.75 to 4.85
Wise county foundry coke	4.25 to 5.00
Scrap	
Heavy melting steel, Valley	$17.25 to 17.75
Heavy melting steel, Pitts.	18.00 to 18.50
Heavy melting steel, Chicago	14.75 to 15.25
Stove plate, Buffalo	12.00 to 12.50
Stove plate, Chicago	11.50 to 12.00
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	14.50 to 15.00
No. 1 cast, Philadelphia	16.00 to 17.00
No. 1 cast, Pittsburgh	15.00 to 16.00
No. 1 cast, Birmingham	14.00 to 15.50
Car wheels, iron, Pittsburgh	16.25 to 16.75
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	17.00 to 17.50
Agricultural mal., Chicago	16.00 to 16.50
Malleable, Buffalo	18.00 to 18.50
Nonferrous Metals	Cents per pound
Casting, copper, refinery	17.37½
Electro, copper, producers	18.00
Straits tin	45.12½
Lead, New York	6.90
Antimony, New York	8.50
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	6.70 to 6.80











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

ALEXANDER BLACKWOOD, formerly general manager of the Chicago Steel Foundry Co., Chicago, but who resigned that post last September to organize and head the International Steel Corp., Canton, O., has resigned the latter connection to become general manager of the Wehr Steel Co., Milwaukee. Mr. Blackwood has had extensive experience in steel foundry management. For seven years he was vice president of the Michigan Steel Casting Co., Detroit, and for three years was general manager of the Farrell-Cheek Steel Foundry Co., Sandusky, O.

M. Vuilleumiez, Machine Fabrique Oerlikon, Founderie Ingenieur, Zurich, Switzerland, now is visiting in the United States.

Edward R. Williams was elected vice president of the Vulcan Mold & Iron Co., Latrobe, Pa., a newly-created office.

Roy C. McKenna, president of the Vanadium Alloys Steel Co., Latrobe, Pa., recently was elected a director of the Vulcan Mold & Iron Co., Latrobe, Pa.

George Davies, Davies & Thomas Co., Catasauqua, Pa., joined the overseas delegation of the American Foundrymen's association at the London convention and now is touring the continent.

Charles E. Johnson, president of the Piston Ring Co., Muskegon, Mich., recently was chosen general chairman of the Greater Muskegon chamber of commerce campaign for $50,000 for airport development.

B. H. Johnson, formerly connected with the Cresson-Morris Co., Philadelphia, has become associated with R. D. Wood & Co., Philadelphia, and now is located at the plant of the Florence Pipe Foundry & Machine Co., Florence, N. J.

E. A. Perry has been appointed purchasing agent of the National Radiator Corp., with headquarters at Johnstown, Pa. The appointment was effective July 1, when Mr. Perry succeeded R. D. Felton, resigned. Mr. Perry was assistant to Mr. Felton for some years.

J. F. Gaffney, formerly superintendent of the foundry of the Bethlehem Steel Co., Sparrow's Point, Md., and for the past 5 years foundry superintendent of the Toledo Machine & Tool Co., Toledo, O., has returned to the Bethlehem organization in the pig iron sales department. Mr. Gaffney's headquarters will be in Chicago.

Charles Pack, who recently resigned as first vice president and assistant general manager of the Doehler Die Casting Co., Brooklyn, N. Y., after a 13-year connection, has established

ALEXANDER BLACKWOOD

headquarters at 233 Broadway, New York, as consulting engineer in the die casting industry. He specializes in new installations of production equipment.

Frank J. Dutcher, since 1909 president of the Draper Co., Hopedale, Mass., manufacturer of textile machinery, resigned to become chairman of the board. E. H. Bristow Draper, treasurer, was appointed president to succeed Mr. Dutcher, and C. Frederick Butterworth, formerly assistant treasurer, now is treasurer. G. Russell Goff is the new assistant teasurer, succeeding Mr. Butterworth.

F. A. Merrick, formerly vice president and general manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been elected president of that company. Mr. Merrick succeeds E. M. Herr, president of the Westinghouse company since 1911. Mr. Merrick received his technical training at Lehigh university and shortly after graduation was employed by the Steel Motors Co., a subsidiary of the Lorain Steel Co., Johnstown, Pa. When the Standard company was acquired by the Westinghouse Electric & Mfg. Co., he joined the latter company. Mr. Merrick prepared the plans for the Canadian plant of the company and in 1903 was sent to Canada as superintendent of the Canadian Westinghouse Co. Ltd. Later he became vice president and general manager of the Canadian company. After the war he served as special representative of the Westinghouse Electric International Co., in London. In 1925 he was elected vice president and general manager of the company and also a director, which positions he held until his recent election as president.

Refractories Institute Elects New Officers

Porter S. Kier, Kier Fire Brick Co., Pittsburgh, was elected president of the American Refractories institute at the business meeting held in Cleveland June 25. He succeeds J. M. McKinley, North American Refractories Co., Cleveland. This session did not include the presentation of the usual technical papers, the program consisting only of business matters. A meeting has been scheduled for Sept. 24-25 at Columbus, O., at which time the regular annual technical program will be carried out.

Other officers elected at the recent meeting are as follows: First vice president, W. B. Coullie, Harbison-Walker Refractories Co., Pittsburgh; second vice president, Roger A. Hitchins, General Refractories Co., New York; treasurer, C. C. Edmunds, McLain Fire Brick Co., Pittsburgh; secretary, Dorothy A. Texter, Oliver building, Pittsburgh.

Philadelphia Foundrymen Elect Officers

C. F. Hopkins, vice president, Ajax Metal Co., Philadelphia, has been elected president and B. H. Johnson, R. D. Wood & Co., Florence, N. J., has been chosen vice president of the Philadelphia Foundrymen's association.

Frederick M. Devlin, president of the Philadelphia Hardware & Malleable Iron Works Inc., and George M. Benkert, president of the Fairmount Foundry Inc., have been elected directors of the association for a term of three years.

Obituary

Charles E. Bell, 79, president of the C. S. Bell Co., Hillsboro, O., died June 11 at his home in that city, following an extended illness.

Frederick Cadmus, 67 years old, a retired foundryman, died suddenly at his home in Glen Ridge, N. J., June 28. Mr. Cadmus was the son of the late Thomas T. Cadmus of Bloomfield.

Ira Leroy Werner, 53, for nearly a quarter of a century experimental expert for the Oliver Chilled Plow Co., now the Oliver Farm Equipment Co., died recently. He entered the employ of the Oliver main plant at South Bend, Ind., in 1906, previously being associated with the Kansas City branch. He was born in Hamilton, Mo.

Oliver Ames, 64, owner of the Ames Shovel & Tool Co., North Easton, Mass., and president of the Ames Plow Co., died at his home in North Easton, June 19. He was born in that city, Oct. 21, 1864, and was graduated from Harvard university in 1886 with an A. B. degree. He was a financier of note and was connected with a large group of industrial and banking enterprises. The shovel works of which he was the owner is one of the oldest in the country.

Church Alexander Williams, formerly identified with the steel business in the Pittsburgh district, died at the West Penn hospital, Pittsburgh, June 23. He was associated with the Illinois Steel Co., Chicago, for a number of years and later served as superintendent of the Verona Steel Casting Co., Verona, Pa., now a part of the American Steel Foundries. During the war, he was open-hearth superintendent of the Tata Iron & Steel Co. of India. In recent years he was identified with the insurance business in Pittsburgh.

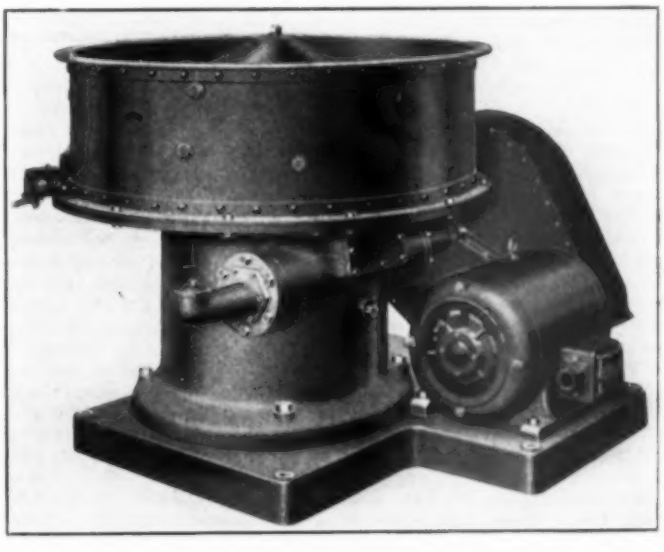
Edward B. Thornton, president of the Ottawa Silica Co., Ottawa, Ill., died June 28 at his home in Bedford, Ind. Mr. Thornton was the founder of the Ottawa Silica Co., and had served as its president since its organization. Mr. Thornton also was president of the Bedford Citizens National bank and at one time was president of the Bedford Steam Stone Works and of the Imperial Stone Co., Bedford, Ind. He has been active in civic and business affairs in Bedford, which had been his lifelong home. One of his two sons, George A. Thornton, is secretary and treasurer of the Ottawa Silica Co.

New Type of Sand Mixer Attracts Notice

The sand mixing machine with moving and fixed blades arranged in a circular stationary pan, shown in the accompanying illustration, attracted considerable attention at the recent foundry exhibition in London, England. It is claimed the action of the blades produces such an intensive kneading, rubbing and squeezing action on the materials to be mixed that complete union takes place in 3 minutes. An automatic discharge empties the batch of 448 pounds in 30 seconds.

The pan is mounted over a pedestal casting which carries all bearings and encloses the worm transmission gearing. The transmission is submerged in oil, and oil is pressure fed to the vertical shaft which carries the moving blades. Contents of the pan are isolated from the gear chamber and top bearing of the moving blade shaft.

When operating on core sand bonded with binder in any form, paste, liquid or solid, it is claimed the machine rapidly will distribute the whole of the bonding material as an even coating over each sand grain. Strong green bond is obtained without detrimental effect on the venting quality of the sand. It is claimed that the strength of the sand is increased 100 per cent and the permeability 45 per cent. The machine is applicable to the preparation of compounds for molding steel castings, for ganisters and similar refractory material and for intensive mixing of dry powders. It is fitted with a novel design, self cleaning, quick acting discharge shutter either hand or pneumatically operated. The machine illustrated is actuated by an electric motor driving the transmission shaft through an automatic centrifugal clutch and spur gearing enclosed in a dust tight steel casing. The machine was developed by C. & B. Smith, Wolverhampton and is distributed by the Fordath Engineering Co., West Bromwich, England.



Three Minutes Are Necessary to Mix 448 Pounds of Sand in This Type Mixer

Eliminates White Fracture

(*Concluded from Page* 614)

temperature it is possible that the phosphide eutectic will segregate into larger areas than normal and in the cooling time at the critical point will not be completely dissolved by the carbon free iron and will remain to weaken the grain boundaries. Similarly the presence of high silicon may have a bearing on the solubility of phosphorus in iron, just as it has on iron carbide.

To fix the blame entirely on the presence of phosphorus at the grain boundaries it would be necessary to show that some form of phosphorus would be weak and brittle when cold; that is, at about 50 degrees Fahr., and strong and ductile at 250 degrees Fahr. Also, that quick chilling from 1200 degrees Fahr. would lower the embrittlement temperature to a point well below zero degrees and that heat treatment at 850 degrees would favor embrittlement. We are not able to shed any light on this subject as our research ended when we found means of avoiding the trouble. The subject is one which deserves investigation in a research laboratory rather than in a plant control laboratory.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Burns Foundry Inc., Battle Creek, Mich., has been incorporated with $20,000 capital.

Otis Elevator Co., Quincy, Ill., is building an extension to its foundry, 120 x 160 feet.

Leavitt Machine Co., 10 East River street, Orange, Mass., has started work on a one-story foundry, 40 x 100 feet.

Chrobaltic Tool Co., 1501 Ferry avenue, Detroit, has completed an addition to its No. 2 foundry at Michigan City, Ind.

Model Brass Foundry, Decatur, Ill., is erecting an addition to its plant including a machine shop, 24 x 40 feet.

Construction work on the additions to the Eagle Foundry Co., Bellville, Ill., is progressing rapidly. (Noted June 15.)

Empire Steel Castings Inc., Reading, Pa., has an extension to its foundry under construction. (Noted June 15.)

White Metals Architectural Products Corp., New York, has been incorporated by J. W. T. Thompson.

Deere & Mansur Co., Fourth street and Third avenue, Moline, Ill., will construct an addition to its foundry.

Die Casting Equipment & Enginering Co., New York, has been incorporated with 100 shares of common stock, by H. W. Stephen, 120 Broadway, New York.

Akron Foundry Co., Akron, Ind., recently incorporated, expects to have its new foundry building in operation by August 1. (Noted July 1.)

Centri Cast Corp., Cleveland, has been incorporated with $10,000 capital to manufacture and deal in metal products, by A. C. Lorman, Society for Savings building, Cleveland.

North Dighton Stove Co., North Dighton, Mass., H. H. Lincoln president, is said to have plans for rebuilding its plant recently damaged by fire. (Noted June 15.)

The General Steel Castings Corp., Eddystone, Pa., will pay approximately $35,000,000 for the property of the Commonwealth Steel Co., Granite City, Ill., which it contracted to buy some time ago.

Anthes Foundry Co., 64 Jefferson avenue, Toronto, Ont., and Winnipeg, Man., has purchased a site at Calgary, Alta., and propose to start work soon on the erection of a new plant.

Onsurd Machine Works, Inc., 3908 Palmer street, Chicago, is erecting a foundry, 80 x 150 feet, which will be rendy for occupancy in about two months.

Jones & Hernandez Foundry & Machine Co., Birmingham, Ala., has built a new shop on Avenue A between Thirty-eighth and Thirty-ninth streets, 75 x 150 feet, for the manufacture of soft drink bottle coolers.

General Bronze Co., 3212 Smallman street, Pittsburgh, has purchased the Flour City Ornamental Iron Co., Minneapolis, and will consolidate it with the General company. Plans for a $500,000 plant extension program now are under way at the Flour City company.

Pennsylvania Brass & Bronze Co., Inc., Philadelphia, has moved its offices to Twentieth street above Hunting Park avenue. The company will continue to operate its brass foundry at Twenty-second and Master streets.

Service Station Equipment Co., 37 Parkman street, Brighton, Mass., has been incorporated with 5000 shares of no par stock to manufacture and deal in pumps, gauges, castings, tanks, etc. Laurence P. Manning, is president.

Hull Steel Foundry Co. Ltd., Montcalm street, Hull, Que., plans construction of a 4-story foundry, 90 x 300 feet. Electrically operated heat treating ovens will be included. Estimated cost is about $200,000.

Sparta Foundry Co., Sparta, Mich., will add two units to its plant as well as increasing the floor space from 80,000 to 100,000 square feet, according to Randall W. Harper director. Estimated cost will be about $100,000.

Bro-Dun Metal Products Co., Lancaster, Pa., has been incorporated with $25,000 capital, by Jerome S. Dunie, North West End avenue and McKinley avenues, Lancaster, to manufacture and sell castings and kindred metal products.

Philip Gies Foundry Ltd., Kitchener, Ont., has been incorporated to carry on a general foundry business, with $200,000 capital by Philip Gies, William Pope Clements and Gerald E. Eastman, all of Kitchener.

Van Loon Pattern Works, Anderson, Ind., will operate under the name of the Wandtke Pattern & Foundry Co. after July 1. The company is located in a new and larger plant at 1700 Ohio avenue.

Howorth Machine Co., Rapid City, S. D., and Hogarth & Son Inc., Deadwood, S. D., have consolidated and will establish a machine shop in Rapid City, costing about $60,000. A foundry will be added later.

American Electro Metal Corp., Lewiston, Me., has authorized an addition to its new plant now under construction. Additional buildings will be constructed in the fall, including a foundry. The entire project will cost in excess of $150,000.

Sidney Brass Works Co., Sidney, O., manufacturer of brass, bronze and aluminum castings, has taken over the Wapak Holloware Co., Wapakoneta, O., manufacturer of cooking untensils, and will begin operations of that plant about July 1. George Trautman is president and general manager.

Pittsburgh Stove & Range Co., Pittsburgh, has been taken over by a new company having the same name. The new company is capitalized at $400,000. In addition to the manufacture of stoves and ranges, a general iron foundry will be operated. The incorporators of the new company include Robert V. Bingay and Carl A. Karthauser. The latter is the treasurer of the company.

DeLaval Separator Co., Pine street, Poughkeepsie, N. Y., has awarded the general contract for a one-story foundry addition to L. H. Swenson, 39 Market street. The building and equipment will cost about $100,000. Headquarters of the DeLaval company are at 165 Broadway, New York. (Noted April 15.)

Eagle Bronze Works, Inc., 10 North Bleeker street, Mt. Vernon, N. Y., has awarded a general contract to Barbaresi & Son, 20 east Fifth street, for a four-story addition and improvements to the present plant. The construction and equipment will cost about $45,000. George M. Bartlett, 103 Park avenue, New York, is the architect.

Austin Machinery Corp. of Michigan and the West Michigan Steel Foundry Co., both of Muskegon, Mich., are being merged. Each will operate as a separate division of the merged company and each plant will be enlarged. Austin Machinery Corp., manufactures trench excavating and backfilling machinery, cranes and similar devices. West Michigan Steel Foundry Co. produces electric steel castings.

Auto Specialties Mfg. Co., Inc., St. Joseph, Mich., has purchased a 6-ton electric furnace from the Pittsburgh Electric Furnace Corp., Pittsburgh. Link-Belt Co., Chicago, has installed complete sand-handling, continuous molding and sand conditioning equipment for the same company. The St. Joseph company has completed an addition to its malleable shop, providing for additional capacity.

Officials of the Axelson Machine Co., 6160 South Boyle avenue, Los Angeles, manufacturer of oil well pumps, gray iron castings, etc., have organized the Axelson Airplane Engine Co., a subsidiary, to manufacture aircraft engines and parts. Plans are under way for a new plant on a 3 acre tract at Huntington Park, Calif., which will consist of a one-story building 120 x 220 feet, for the production of parts and assembling. The new building and machinery will cost about $90,000.

New Trade Publications

BLOWERS—Connersville Blower Co., Connersville, Ind., recently has published a folder on the gas boosters which that company manufactures. The principles of operation, features and advantages are discussed.

AUTOMATIC-CONTROL PANELS—General Electric Co., Schenectady, N. Y., has issued a folder on its automatic-control panels for industrial electric heating. The folder describes these devices and gives several illustrations showing typical installations.

PROTECTIVE COATINGS—American Wurtzilite Co., Chicago, is distributing a leaflet describing its paints, coatings and binders for protective and industrial uses. They are used for waterproofing, acid and alkali proofing, heat resisting, dielectric and adhesive purposes.

MANGANESE STEEL—American Manganese Steel Co., Chicago, recently has issued a folder on the shock-abrasion and corrosion alloys that it manufactures. The folder tells some of the uses of those kinds of steel and gives illustrations of several different types of castings.

CIRCUIT BREAKERS—Roller-Smith Co., 233 Broadway, New York, in a current bulletin describes the construction, design and application of its oil circuit breakers. The bulletin also contains illustrations and descriptions of many of its auxiliaries and attachments. Tables give much data on breakers used in different type circuits.

GAS ENGINES—Chicago Pneumatic Tool Co., 6 East Forty-fourth street, New York, recently issued a bulletin on its vertical gas engines. The folder contains a general description of the engines. Details of construction and illustrations of many of the pieces which make the assembled engine also are included. Sectional views and dimensional drawings which show the specifications for the various sizes of engines feature the bulletin.